(1)

DOT/FAA/CT-88/8-3

FAA Technical Center
Atlantic City International Airport
N.J. 08405

Aircraft Icing Handbook
Volume 3 of 3

March 1991

This document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161

U.S. Department of Transportation
Federal Aviation Administration

NOTICE

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT/FAA/CT-88/8-3		

4. Title and Subtitle
Aircraft Icing Handbook -
Volume 3 of 3

5. Report Date
March 1991

6. Performing Organization Code

7. Author(s) A. Heinrich, R. Ross, G. Zumwalt, J. Provorse, V. Padmanabhan, J. Thompson, J. Riley

8. Performing Organization Report No.
DOT/FAA/CT-88/8-3

9. Performing Organization Name and Address
Gates Learjet Corporation
8220 W. Harry
Wichita, KS 67277

10. Work Unit No. (TRAIS)

11. Contract or Grant No.
DTFA03-85-C-00007

12. Sponsoring Agency Name and Address
Department of Transportation
Federal Aviation Administration Technical Center
Atlantic City International Airport, NJ 08405

13. Type of Report and Period Covered
Final Report
February 1985-March 1991

14. Sponsoring Agency Code
ACD 230

15. Supplementary Notes
FAA Technical Monitor, E. E. Schlatter
Flight Safety Research Branch
ACD 230

16. Abstract

The design and validation of adequate aircraft ice protection has evolved into a specialized and technically complex area where many engineering disciplines are involved; namely, aeronautical, electrical, mechanical, electronics, chemical simulations, mathematical modeling, airframe/engine systems design, atmospheric physics, and meteorology. Research advances in any one discipline have a direct effect on updating the procedural technology used in the design and validation of ice protection configurations, equipment, and systems. Periodically the Federal Aviation Administration (FAA) provides documentation to assist regulatory certification teams and industry design engineers in standardizing testing and validating procedures. Examples of such documentation are "Engineering Summary of Airframe Icing Technical Data," FAA Report No. ADS-4 dated December 1968, and "Engineering Summary of Powerplant Icing Technical Data," FAA Report No. RD-77-76 dated July 1977. Although most of the information contained in these reports is still valid, some is outdated, and more usable information is now available through recent research and experience. Therefore, this work was directed towards developing an updated and more comprehensive combined version of Report ADS-4 and RD-77-76 that includes reference material on ground and airborne icing facilities, simulation procedures, and analytical techniques. This document represents all types and classes of aircraft and is intended as a working tool for the designer and analyst of ice protection systems. (25)

17. Key Words
Aircraft Icing, Atmospheric Icing, Icing Measurements, Anti-Icing, Ice Protection, Icing Certification, De-Icing systems, Helicopter Icing

18. Distribution Statement
Document is available to the U. S. public through National Technical Information Service, Springfield, Virginia.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified.	Unclassified.	253	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

** NOTICE **

This Handbook is maintained by the:

FAA Technical Center
Aircraft Icing E&D Program
Flight Safety Research Branch, ACD-230
Atlantic City Int'l Airport, NJ 08405

Handbook changes will be transmitted in the form of either ERRATA or REVISIONS. ERRATA will be notices of pen & ink corrections and REVISIONS will consist of reprinted pages, sections, or chapters. Each revised page will contain the revision number and date. This page can be used to track changes made to each volume of the Handbook.

It would be appreciated if readers would notify the Aircraft Icing E&D Program Manager at the above address of any necessary corrections, or any other appropriate comments.

CHANGE No.	ERRATA No.	REVISION No.	APPLICABLE PAGES	DATE ENTERED

DOT/FAA/CT-88/8-3

CHAPTER VI
REGULATORY MATERIAL

SECTION 1.0 - U.S. CIVIL AVIATION REGULATIONS
SECTION 2.0 - U.S. MILITARY SPECIFICATIONS
SECTION 3.0 - FOREIGN REGULATIONS

CHAPTER VI

SECTION 1.0

U.S. CIVIL AVIATION REGULATIONS

CHAPTER VI

CONTENTS

SECTION 1.0 U.S. CIVIL AVIATION REGULATIONS

LIST OF TABLES

LIST OF FIGURES

SYMBOLS AND ABBREVIATIONS

Symbol	Description
AC	Advisory Circular
AGL	Above Ground Level
ATR	Air Transport Rating
°C	Degrees Celsius
CAR	Civil Air Regulation
DOT	Department of Transportation
°F	Degrees Fahrenheit
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
IFR	Instrument Flight Rules
LWC	Liquid Water Content
m	Meters
MVD	Median Volumetric Diameter
OAT	Outside Air Temperature
SFAR	Special Federal Aviation Regulation
STC	Supplemental Type Certificate
TC	Type Certificate
VFR	Visual Flight Rules

GLOSSARY

liquid water content (LWC) - The total mass of water contained in all the liquid cloud droplets within a unit volume of cloud. Units of LWC are usually grams of water per cubic meter of air (g/m^3).

median volume diameter (MVD) - The droplet diameter which divides the total water volume present in the droplet distribution in half; i.e., half the water volume will be in larger drops and half the volume in smaller drops. The value is obtained by actual drop size measurements.

micron (μm) - One millionth of a meter.

VI.1.0 U.S. CIVIL AVIATION REGULATIONS

VI.1.1 INTRODUCTION

The purpose of this section is to provide a review of U.S. Civil Aviation Regulations, i.e., Federal Aviation Regulations (FARs) relating to aircraft and engine certification for operations in known icing conditions. The applicable regulations are FAR Part 23 (reference 1-1), SFAR 23 (reference 1-10), and FAR part 25 (reference 1-2) for normal, small commuter, and transport category airplanes, respectively. (Large aircraft are defined as having takeoff gross weights in excess of 12,500 pounds.) FAR Parts 27 (reference 1-3) and 29 (reference 1-4) apply to normal (weight less than 6,000 pounds) and transport category rotorcraft, respectively; and FAR Part 33 (reference 1-5) applies to aircraft engines.

To be approved for flight into known icing conditions, an aircraft must be equipped with ice protection systems which are designed to provide protection when the aircraft is exposed to the icing conditions likely to be encountered in service, which is further quantified by reference to the FARs. There are two types of regulatory references to ice protection; one provided by the aircraft type design certification rules set forth in Federal Aviation Regulations Parts 23, 25, 27, 29, 33, and SFAR 23, and the other provided by the operating rules of Federal Aviation Regulations Parts 91, 121, and 135 (references 1-6 through 1-8).

Aircraft and engine type design certification, concerning ice protection, is accomplished by meeting the requirements of the appropriate FAR sections delineated below:

FAR Part 23

- 23.929
- 23.975
- 23.1093
- 23.1095
- 23.1097
- 23.1099
- 23.1101
- 23.1105
- 23.1309
- 23.1325
- 23.1416
- 23.1419
- 23.1559b
- 23.1583h

SFAR 23.34

FAR Part 25

25.929

25.975

25.1093

25.1105

25.1309

25.1323

25.1325

25.1403

25.1416

25.1419

Appendix C

FAR Part 27

27.1093

27.1419

27.1525

27.1583

FAR Part 29

29.1093

29.1101

29.1157

29.1419

29.1525

29.1583

AppendixC

FAR Part 33

33.66

33.68

33.77

In addition, there are two related Special Federal Aviation Regulations (SFARs). These are:

SFAR 29-4 (reference 1-11)

SFAR 41 (reference 1-12)

Along with SFAR 23, SFAR 41 pertains to certification of FAR Part 23 (reference 1-1) airplanes and SFAR 29-4 pertains to operation of helicopters in IFR conditions. SFAR 41 and SFAR 29-4 do not address aircraft icing requirements and therefore will not be discussed in the applicable FAR sections. The effectiveness of these SFARs is very limited and production of aircraft certified under their rules will cease in 1991.

The above rules give the minimum requirements for the design of aircraft and aircraft systems for safe flight into known icing conditions and define the meteorological parameters upon whcih these requirements are based. Compliance with the FARs normally requires a combination of analyses and testing because testing rarely can be performed at critical design points. Tests of the ice protection system must be conducted or similarity analyses must be performed to demonstrate that the airplane is capable of operating safely in continuous maximum and intermittent maximum icing conditions as defined in Appendix C of FAR Part 25 (reference 1-2) or Appendix C of FAR Part 29 (reference 1-4). A different baseline of icing conditions has been reported by Masters (reference 1-13) for altitudes below 10,000 feet (3048 m). Applicants, i.e., rotorcraft and certain small airplanes, may elect to seek certification for these altitude limited criteria; however these criteria should be treated as guidance since they are not regulatory.

The operating rules and aircraft ice protection systems required for flight into known or forecast icing conditions are given in the following:

FAR Part 91 (reference 1-6)

91.209

91.31

FAR Part 121 (reference 1-7)

121.341

121.342

121.629

FAR Part 135 (reference 1-8)

135.227

Appendix A, Paragraph No. 34

These rules require that no pilot fly under IFR into known or forecast icing conditions; or under VFR into known light or moderate icing conditions; unless the aircraft has functioning ice protection systems protecting each propeller, windshield, wing stabilizing or control surface, and each airspeed, altimeter, rate of climb, or flight attitude system. Except for an airplane that is equipped with ice protection systems that meet the requirements in Section 34 of Special Federal Aviation Regulations (SFAR) No. 23, or those for transport category airplane type certification, no pilot may fly an airplane into known or forecast severe icing conditions.

Current regulations state that any equipment intended for de-icing or anti-icing must be shown to comply with the pertinent FARs before the FAA considers it to perform its intended function. In addition, unless operations at night in known or forecast icing conditions are prohibited by an operating limitation, a means must be provided for illuminating or otherwise determining the formation of ice on parts of the wings that are critical from the standpoint of ice accumulation (reference 1-2).

VI.1.2 FEDERAL AVIATION REGULATIONS (FARs)

1.2.1 FAR Part 23 (Normal Category Airplanes)

1.2.1.1 Introduction

The first small non-turbine powered airplanes were approved for flight into known icing conditions under CAR Part 3 (reference 1-14). However, some FAA guidance material was also suggested which added the following criteria:

a. Conduct suitable tests under simulated icing conditions, or

b. Make a rational analysis of the equipment based on similar types of equipment already known to fulfill its intended function.

The following areas were suggested by the FAA to require ice protection:

a. Airspeed, altimeter, and rate of climb systems

b. Propeller surfaces

c. Flight surfaces

d. Cockpit visibility, during approach and landing

e. External radio masts or antennas

From these early requirements, icing certification has evolved more specific requirements which have been integrated into Part 23 (reference 1-1). Actually, the intent has not changed significantly, as can be seen by reviewing appropriate sections of references 1-1 and 1-14. The requirements listed in this Handbook reflect the current requirements. Further guidance on certification of small airplanes is found in references 1-15 and 1-16. The ice protection systems must be shown to meet these requirements under the conditions specified in Appendix C of FAR Part 25 (reference 1-2).

1.2.1.2 Airplanes Weighing Less than 12,500 Pounds (5680kg)

The specific paragraphs of FAR Part 23 (reference 1-1) pertaining to icing certification are listed in Section 1.1. Compliance procedures essential in meeting these regulations are discussed in Chapter V. However, there are many other considerations which the FAA has developed as background to these specific requirements. The following paragraphs discuss some of these considerations which form the overall basis for certification.

The principal ice protection requirements are stated in FAR paragraphs 23.1583, 23.929, 23.975, 23.1093, 23.1095, and 23.1419. These paragraphs describe the requirements for airplane flight manual, propeller, fuel vents, induction system, analysis, and tests, respectively, that are necessary for icing certification. In general, compliance can be established when there is reasonable assurance that while operating in the specified icing environment: (1) the engine(s) will not flame out or experience significant power losses or damage; (2) the handling qualities, performance, visibility, and systems operations do not deteriorate unacceptably; (3) external protrusions are not overstressed from ice

accumulation (e.g., antennas) that could endanger the aircraft or cause navigation and communication loss; and (4) inlet scoop blockage (e.g., oil cooler inlet) is not excessive.

Assessment of performance loss should include the drag and weight of the ice accumulated on the airfoil surfaces as well as electrical or other load demands of the ice protection system. It is understood, however, that the ice protected airplane may experience reduced performance and altered handling qualities (although not deteriorated unacceptably) due to ice accretions, even though the ice protection systems have been found to adequately remove or prevent ice build-up while the airplane is operating in icing conditions. The criteria for acceptable performance is based on showing that the airplane does not have any features or characteristics that will prevent it from safe operations when flying in icing conditions.

Compliance with FAR 23.1309 is a requirement for all systems, which covers the affect of a system on other systems and a hazard evaluation of the ice protection systems. Also, since many of the ice protection systems use electrical power for control or electro-thermal heat, compliance with FAR 23.1351 and 23.1357 is required. FAR 23.1351 is a general requirement on the electrical systems and equipment necessary for certification and FAR 23.1357 is a requirement for the provision of circuit protective devices for the airplane electrical system. FAR 23.1559(b) is a requirement for placarding which is employed to delineate airplane operational limitations (inlcuding operations in icing conditions) if the required systems are not installed. Another requirement for compliance is FAR 23.1583(h) which necessitates a statement relating to flight into known icing and listing any limitations in the airplane flight manual.

Windshield

In addition to the principal requirements discussed above, the windshield must comply with FAR 23.773 and 23.775(d). FAR 23.773 requires a thorough evaluation of the pilot's view. Both day and night flight evaluations are necessary to assure adequate visibility through the windshield when the ice protection system is both on and off. One item to consider with an electrically heated windshield is the fuzziness or "starring" effect which may reduce visibility. FAR Part 23 does not require that a defogging system be installed. However, if such a system is installed, it has to be evaluated for its effectiveness in maintaining adequate visibility through the windshield. If observation of wing ice accumulation or ice protection system operation is necessary, the cockpit side window must provide adequate visibility for this function. In some cases, a means of defogging the side window may be necessary.

Consideration should be made for other components such as the magnetic direction indicator. The high power required for an electrically heated windshield may cause magnetic deviations of more than 25 degrees. If a deviation of more than 10 degrees occurs, then a placard per FAR 23.1327 and 23.1547(e) is required.

Propeller

The propeller ice protection requirements are stated in FAR 23.929. Propellers must be protected against the accumulation of ice to enable satisfactory functioning without appreciable power loss in icing conditions. Unsymmetrical ice shedding from a propeller should not cause excessive vibration. In addition, care must be taken to avoid propeller damage from shed ice for a pusher (rear-mounted) engine airplane configuration.

Engine Induction Systems

Engine installation certification requirements for operation in icing conditions are stated in FAR paragraphs 23.1093, 23.1095, 23.1097, 23.1099, and 23.1105. These requirements specify the protection necessary for engine induction systems and carburetor de-icing. For certification the final proof of compliance is, of course, flight tests in natural or simulated icing conditions. The principal concerns are that the engine neither sustain damage nor experience inlet blockage that would result in appreciable power loss. On reciprocating engines, attention should be given to insuring that inlet air ducts are not restricted or blocked by ice accumulations. On turbopropeller engines, care should be taken to ensure that any movable induction air doors do not freeze in place so as to restrict operation. In addition, the inlet lip should be protected from ice accumulation that might shed into the engine and cause damage or serious power loss.

Fuel Vents

Fuel vents must comply with the requirements stated in FAR 23.975. Specifically, FAR 23.975(a)(1) requires fuel vents to be located and constructed to minimize the possibility of being obstructed by ice.

Static Pressure System

In addition to the general requirements listed in Section 1.2.1.2, the static pressure system must comply with FAR 23.1325(b)(3). Static port design or location should be such that the correlation between air pressure in the static system and true ambient pressure is not adversely altered when flying in icing conditions. An anti-icing means or an alternate static source may be used for compliance.

Airfoil Leading Edge Surfaces

The principal requirements for protection of airfoil leading edge surfaces were listed in Section 1.2.1.2. Additional requirements are stated for pneumatic boot de-icer systems in FAR 23.1416. The first step in achieving compliance is to evaluate each leading edge surface and determine if ice protection is actually necessary. There are cases where analysis or testing has demonstrated that some of these surfaces may not require ice protection. Unprotected surfaces are discussed further in Chapter I. The leading edges of lifting or control surfaces such as wings and horizontal stabilizers usually require ice protection.

Pitot Probe

The general requirements for protection of pitot probes were listed in Section 1.2.1.2. Since the airspeed system requires static pressure, the requirements of FAR 23.1325(b)(3) apply. In addition, a pitot probe should be protected against blockage from ice accumulations. This is usually achieved with an electro-thermal heating system.

Air Scoops

Ice protection of air scoop inlet lips or ducts may be required where blockage could affect system operation. Specific examples would be the cooling air requirements that are contained in FAR Paragraphs 23.1041 and 23.1061.

Stall Warning

The stall warning system must comply with the requirements of FAR Part 23.207. Ice protection of the stall warning sensor or transducer may not be necessary if substantiated by analyses. Where ice protection is necessary, FAR Parts 23.1301 and 23.1309 apply. The analysis usually involves the determination of the electrical heat required to prevent icing. In some cases, a successful installation on another aircraft approved for flight into known icing conditions could support and ease the verification process with a properly documented similarity analysis.

Antennas

Ice protection usually is not provided for antennas except to insure that ice shed from the antenna will not damage an essential part of the airplane or that an antenna structural failure, due to ice loading, will not result in a loss of communication or navigation capability. A certain amount of structural integrity must be included in the antenna design unless it adequately selfsheds. The design should include consideration of an exposure to FAR 25, Appendix C icing conditions.

1.2.1.3 Airplanes Weighing More Than 12,500 Pounds (5680 kg)

If the original certification for a Part 23 aircraft was prior to October 17, 1979, the applicant may, with some restrictions, apply for an amended or supplemental type certificate in the normal category for a reciprocating or turbopropeller powered multiengine airplane with a takeoff gross weight greater than 12,500 pounds (5680 kg). This amended or supplemental type certificate is granted under SFAR 41 (reference 1-12). Approval of airplanes certified to this criteria ends in 1991.

1.2.1.4 Special Federal Aviation requirements (SFARs)

The regulations for icing certification of SFAR 23 (reference 1-10) aircraft are similar to the current FAR Part 23 (reference 1-1) regulations. If certification for flight in icing conditions is desired, analyses and tests must demonstrate that the airplane is capable of operating safely in continuous maximum and intermittent maximum icing conditions as described in FAR Part 25, Appendix C (reference 1-2). In addition, SFAR 23.48 requires that there must be a means to indicate to appropriate flight crew members the functioning of the powerplant ice protection system (reference 1-10). The ice protection indicator could show, for example, that the engine anti-icing bleed air valve is open or that the inertial separator vanes are positioned in the ice protection mode. In some cases, the inlet lip could be heated continuously with engine exhaust and no indicator is required. In this case, it would have to be shown that there is no valve to fail and that a duct failure is not probable.

1.2.2 FAR Part 25 (Transport Category Airplanes)

1.2.2.1 Introduction

Transport Category Airplanes were first certified for flight into known icing conditions under CAR Part 4b (reference 1-17). Since that time, the FAA has issued much guidance material and rewritten the regulations. Currently, the ice protection requirements for commercial transports are specified in FAR Part 25 (reference 1-2). Demonstration of ice protection system compliance for unrestricted flight in icing conditions normally involves several paragraphs in FAR Part 25. These were enumerated in Section 1.1.

The requirements for demonstrating ice protection system compliance are contained in FAR Part 25, paragraphs 25.1093, 25.1309, 25.1416, and 25.1419. The specific compliance procedure will be influenced by the aircraft operating characteristics and the type of ice protection system used. In general, compliance can be established when there is reasonable assurance that while operating in the specified icing environment: (1) the engine(s) will not flame out or experience significant power losses or damage; (2) external protrusions are not overstressed from ice accumulations (e.g., antennas) that could endanger the aircraft or cause communication loss; (3) the handling qualities, performance,

visibility and systems operations are not deteriorated unacceptably; and (4) inlet scoop blockage (e.g., oil cooler inlet) is not excessive.

Assessment of aircraft performance during flight in icing conditions must account for the effects of the ice protection systems on electrical/mechanical or other engine load demands, accumulated ice on unprotected surfaces, and any residual ice on protected surfaces. It must be realized that the ice protected airplane may experience somewhat reduced performance and possibly altered handling qualities in severe icing conditions, even though ice protection systems have been proven to adequately remove or prevent ice accumulation while the airplane is operated in other less critical icing conditions.

This summarizes the general requirements of FAR paragraphs 25.1093 and 25.1419. Some requirements, such as FAR 25.1419(a), are straightforward. The following paragraph addresses additional general requirements. Specific requirements are outlined in subsequent paragraphs.

Compliance with FAR 25.1309 is a requirement for all systems which covers the affect of a system on other systems and a hazard evaluation of the ice protection systems. Also, since many of the ice protection systems use electrical power for control or electro-thermal heat, compliance with FAR 25.1351 and 25.1357 are required for electrically powered systems. FAR 25.1351 is a general requirement on the electrical systems and equipment and FAR 25.1357 is a requirement for the provision of circuit protective devices for the airplane electrical system. For certification the entire system, including both operating and monitoring functions, must meet FAR Paragraph 25.1309. This requires that the probability of a failure condition is expected to remain within limits which are related to the consequence of the failure condition. Icing flight approval of prior certified systems may comply with the intent of this paragraph by means of properly documented similarity.

The ice protection requirements of FAR Part 25 defines two meteorological icing condition regimes: continuous and intermittent maximum (as defined in Chapter I). The conditions for these requirements are plotted in figures 1-1 through 1-3 (Continuous) and figures 1-4 through 1-5 (Intermittent). Additional data for altitudes below 10,000 feet (3048 m) has recently been published by Masters (reference 1-13) and may be applied to Part 27 and 29 rotorcraft. This new characterization compared with the current FAR Part 25 Appendix C (reference 1-2) is shown in figures 1-7 and 1-8 for continuous maximum and intermittent maximum respectively.

The foregoing comments summarize the general requirements for FAR Part 25 icing certification. Specific requirements are outlined in the following paragraphs.

1.2.2.2 Windshield

In addition to the general requirements listed in Section 1.2.2.1, the windshield must comply with FAR paragraphs 25.773 and 25.775. FAR 25.773 requires a thorough evaluation of the pilot's view. Both day and night flight evaluations are necessary to assure adequate visibility through the windshield when the ice protection system is both on and off. One item to consider with an electrically heated windshield is the fuzziness or "starring" effect which may reduce visibility when

power is turned on. Also, the defogging system needs to be evaluated for its effectiveness in automatically maintaining adequate visibility through the windshield and compliance with FAR 25.773(a)(1). When observation of wing ice accumulation or ice protection system operation is necessary (see Section 1.2.2.7), the cockpit side window must provide adequate visibility for this function.

Consideration should be made for other components such as the magnetic direction indicator. The high power required for an electrically heated windshield could cause a magnetic deviation of more than 10 degrees. If this does occur, then a placard per FAR 25.1327 and FAR 25.1547 is required.

1.2.2.3 Propeller

The requirements for propeller ice protection are shown in FAR 25.929 (reference 1-2). If a combustible fluid is used for propeller de-icing, then Paragraphs 25.1181 through 25.1185 and 25.1189 may apply. These relate to power plant fire protection. These are in addition to the general requirements shown in Section 1.2.2.1. Although not directly associated with ice protection, propeller exposure to ice shedding should be considered. In some cases, ice shedding from other aircraft surfaces should be considered. In the case of a pusher (rear mounted) engine configuration, consideration should be given to ice shed into the propeller by the wing ice protection system or residual ice which could accumulate and break off. Companies building pusher airplanes have been required to investigate the areas of the airplane forward of the propeller to determine that ice shed will not impact and damage the propeller. Currently, the FAA is handling these cases by special condition.

1.2.2.4 Engine Inlet

The requirements for engine inlet certification for operation in icing conditions are stated in FAR 25.1093. The primary concerns are airflow blockage that would reduce engine performance and engine damage due to ingestion of ice (reference 1-18). The first concern is also addressed in Section 1.2.5 (Engines). The FAA also requires that areas of the airplane be investigated to determine if ice will accumulate on them and shed into the engine; such areas be protected to prevent ice accumulation and shedding. This requirement is stated in FAR Paragraph 25.1091(e).

1.2.2.5 Fuel Vents

Fuel vents must comply with the general requirements listed in Section 1.2.2.1. There are additional requirements which apply to the airplane which require compliance even though icing certification is not an issue. For example, FAR paragraph 25.975 requires fuel vents to be located and constructed to minimize the possibility of being obstructed by ice. Icing certification necessitates the demonstration that no fuel vent blockage occurs during flight into natural icing conditions.

1.2.2.6 Static Pressure System

In addition to the general requirements of Section 1.2.2.1, static pressure systems must comply with FAR paragraph 25.1325 (reference 1-2). FAR 25.1325 requires that static port design or location should be such that the correlation between air pressure in the static system and true ambient pressure is not adversely altered when flying in icing conditions. Compliance with FAR 25.1325 is included in the certification basis for older airplanes seeking icing approval. Heated static ports are usually necessary to show compliance.

1.2.2.7 Airfoil Leading Edge Surfaces

Primarily, compliance to the requirements discussed in Section 1.2.2.1 are necessary. Additional requirements are defined for pneumatic boot systems in FAR 25.1416. Compliance with FAR Paragraph 25.1416(c) has generally been interpreted to require the ability of the crew to observe the wing boot and if night operation is requested, a light for illuminating the wing boot is required. The first step in compliance to the requirements is to evaluate each leading edge surface and determine if ice protection is actually necessary. There are cases where analyses or testing has demonstrated that some of these surfaces may not require ice protection. Unprotected surfaces are discussed further in Chapter I.

1.2.2.8 Pitot Probe

In addition to the general requirements shown in Section 1.2.2.1, compliance with FAR Paragraph 25.1323(e) is required even though icing approval is not requested. This requires a heated pitot or equivalent means of preventing malfunction due to icing. This requirement is always included in the certification basis for older airplanes seeking icing approval. Compliance with FAR Paragraph 25.1326, "Pitot Heat Indicating Systems," is also required.

1.2.2.9 Air Scoops

There are no additional special requirements for air scoops. There are considerations which must be made for some air scoops where blockage could affect the operation of a particular system. Specific installations such as powerplant induction systems, inlet ducts, and induction system screens are covered by FAR paragraphs 25.1091, 25.1093, 25.1103, and 25.1105.

1.2.2.10 Stall Warning

The stall warning system must comply with the requirements of FAR Part 25.207. Ice protection of the stall warning sensor or transducer may not be necessary if substantiated by analyses. Where ice protection is necessary, FAR Parts 25.1301 and 25.1309 apply. The analyses usually involves the determination of the electrical heat required to prevent icing. In some cases, a successful installation on another aircraft approved for flight into known icing conditions could support and ease the verification process with a properly documented similarity analysis.

1.2.2.11 Antennas

Ice protection is usually not provided for antennas except to insure that ice shed from the antenna will not damage an essential part of the airplane or that an antenna structural failure, due to ice loading, will not result in a loss of communication or navigation capability. A certain amount of structural integrity must be included in the antenna design unless they adequately self-shed. The design should include consideration of an exposure to FAR 25 (Appendix C) icing conditions.

1.2.3 FAR Part 27 (Normal Category Rotorcraft)

Few helicopter operators have shown interest in qualifying small or normal (gross weight less than 6,000 pounds) category rotorcraft for operation in icing conditions. Designing a full ice protection system and demonstrating compliance will be a costly and time consuming exercise. FAR Part 27 (reference 1-3) contains three paragraphs that make reference to icing. FAA Advisory Circular 29-2 (reference 1-20) also contains three paragraphs that are helpful in showing compliance to Part 27 requirements pertaining to flight in icing conditions. The applicable FAR paragraphs are presented in Section 1.1. The information contained in FAA Advisory Circular 29-2 is reviewed in Chapter VII.

Only slight differences exist between requirements of FAR Part 27 (reference 1-3) and FAR Part 29 (reference 1-4) (see Paragraph 27.1093). Safe operation (Paragraph 27.1419) in the icing envelope of FAR Part 29 Appendix C is required. These icing envelopes are the same as presented in FAR Part 25 (reference 1-2) Appendix C. At the time these envelopes were derived, it was assumed that all airplanes would operate to at least 22,000 feet (6700 m). For present state-of-the-art rotorcraft, this assumption is not entirely valid. Hence, an altitude limited icing envelope, based on the same data used to derive the FAR Part 25 Appendix C envelope, is presented in FAA Advisory Circular 29-2 (reference 1-20) as an alternate to the full icing envelope. In addition, the recent work by Masters (reference 1-13) recommends a new characterization for altitudes below 10,000 feet (3048 m). However, neither of these latter characterizations are regulatory but are offered as options, selectable by the applicant.

1.2.4 FAR Part 29 (Transport Category Rotorcraft)

Many helicopter operators have shown interest in qualifying transport category rotorcraft for operation in icing. Transport category rotorcraft manufacturers have conducted rotor icing trials, but most of these efforts have not been completed. Designing a full ice protection system and demonstrating compliance has been a costly and time consuming exercise. FAR Part 29 (reference 1-4) and FAA Advisory Circular 29-2 (reference 1-20) each contain three paragraphs that make reference to icing (FAR 29.877 has been superceded by FAR 29.1419 although the FAA Advisory Circular retains the older paragraph references). The applicable FAA paragraphs are presented in Section 1.1. The information contained in FAA Advisory Circular 29-2 is discussed in detail in Chapter VII.

The icing envelopes for Transport Category helicopters is contained in FAR Part 29 Appendix C. These are identical to those of FAR Part 25 Appendix and are presented in figures 1-1 through 1-6. These icing envelopes have served as a satisfactory design criteria for fixed wing operations in icing conditions for over two decades. The envelopes extend to 22,000 feet (6700 m) with possible extensions to 30,000 feet (9140 m) and does not present icing severity as a function of altitude. At the time the envelopes were derived, it was assumed that all transport category airplanes would operate to at least 22,000 feet. For present state of the art rotorcraft, this assumption is not valid. Thus an altitude limited icing envelope, based on the same data used to derive the FAR part 25 (reference 1-2) Appendix C envelope, is presented in FAA AC 29-2 as an alternate to the full icing envelope. These envelopes are reproduced and presented as figures 1-9 through 1-12. In addition, recent work by Masters (reference 1-13) recommends a new characterization for altitudes below 10,000 feet (3048 m). These envelopes, as compared to FAR Part 25 Appendix C, are presented in figures 1-7 through 1-8. Neither of these latter envelopes are regulatory but are offered as options.

1.2.5 FAR Part 33 (Engines)

In order to become certified for flight by the Federal Aviation Administration, aircraft engines must demonstrate (by test, analysis or similarity) that they are capable of operating successfully in icing conditions (reference 1-5). In addition, the gas turbine engine must be capable of withstanding the foreign object ingestion test of FAR 33.77 without failure or hazard. The engine should be designed and demonstrated to be capable of ingestion of the most severe ice accumulation that could occur for the particular installation. The pertinent paragraphs of FAR Part 33 are listed in Section 1.1.

FAR paragraph 33.66 specifies that if bleed air from the engine is used for engine anti-icing and can be controlled, provision must be made for a means to indicate to the flight crew that the engine ice protection system is operating.

FAR 33.68 specifies the icing requirements for engine induction systems. The FAR Part 25 appendix C icing conditions apply and were discussed in Chapter I and are presented in figures 1-1 through 1-6 (reference 1-1). FAR 33.68(a) requires that the engine must operate throughout its flight power range without the accumulation of ice on engine components that would adversely affect engine operation or that would cause a serious loss of power or thrust in continuous maximum and intermittent maximum icing conditions. FAR 33.68(b) requires that the engine must be able to idle for 30 minutes on the ground with available air bleed for ice protection at its critical condition without adverse effect in a specified atmospheric condition, followed by a momentary operation at takeoff power or thrust.

The non-specific nature of FAR 33.68(a) allows each engine manufacturer to work out a set of mutually agreeable compliance tests with the Federal Aviation Administration pertaining to his specific engine in his specific test facility (reference 1-21).

FAR 33.77 states the foreign object ingestion requirements for engines. Paragraph 33.77(c) states that ingestion of water, ice, or hail, under prescribed conditions, may not cause a sustained loss of power or thrust or require the engine to be shut down. The ice ingestion requirement is presented in table 1-1. Paragraph 33.77(d) states that if the engine incorporates a protection device (e.g., a screen) in the engine inlet, then the ingestion requirement is waived if the ice cannot pass through the protective device, the protective device will withstand the impact of the ice, and if the ice stopped by the protective device does not obstruct the flow of induction air into the engine with a resultant loss of power or thrust greater than those values specified in FAR paragraph 33.77. Experience has shown that ice can build up on the back side of such screens with the potential of engine damage should the ice shed from the screen.

In general, ice protection systems on engines intended for installation in helicopters are subject to the same standards as for fixed wing aircraft engines. Some interesting helicopter icing phenomena which apply in a secondary manner to the engine are reported in reference 1-21 (FAA-RD-77-76, page 6-7).

VI.1.3 REFERENCES

1-1 "Airworthiness Standards: Normal Category Airplanes," Federal Aviation Regulations, FAR Part 23, U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., 1986.

1-2 "Airworthiness Standards: Transport Category Airplanes," Federal AviationRegulations, FAR Part 25, U.S, Department of Transportation, Federal Aviation Administration, Washington, D.C., 1986.

1-3 "Airworthiness Standards: Normal Category Rotorcraft," Federal AviationRegulations, FAR Part 27, U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., 1986.

1-4 "Airworthiness Standards: Transport Category Rotorcraft," Federal Aviation Regulations, FAR Part 29, U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., 1986.

1-5 "Airworthiness Standards: Aircraft Engines," Federal Aviation Regulations, FAR Part 33, U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., 1986.

1-6 "General Operating and Flight Rules," Federal Aviation Regulations, FAR Part 91, U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., 1986.

1-7 "Certification and Operations: Domestic, Flag, and Supplemental Air Carriers and Commercial Operators of Large Aircraft," Federal Aviation Regulations, FAR Part 121, U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., 1986.

1-8 "Air Taxi Operators and Commercial Operators," Federal Aviation Regulations, FAR Part 135, U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., 1986.

1-9 "Airplane Deice and Anti-Icing Systems," U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., AC 91-51, September 15, 1977.

1-10 Special Federal Aviation Regulation, SFAR Number 23, U.S.Department ofTransportation, Federal Aviation Administration, Washington, D.C., 1986.

1-11 Special Federal Aviation Regulation, SFAR Number 29-4, U.S.Department ofTransportation, Federal Aviation Administration, Washington, D.C., 1986.

1-12 Special Federal Aviation Regulation, SFAR Number 41, U.S.Department ofTransportation, Federal Aviation Administration, Washington, D.C., 1986.

1-13 Masters, C.O., "A new Characterization of Supercooled Clouds Below 10,000Feet AGL," DOT/FAA/CT-83-22, Washington, D.C., 1983.

1-14 "Airplane Airworthiness Normal, Utility, and Acrobatic Categories," Civil Air Regulations, CAR Part 3, Federal Aviation Agency, Washington, D.C., 1962.

1-15 "Aircraft Ice Protection," U.S.Department of Transportation, FederalAviation Administration, AC 20-73, April 21, 1971.

1-16 "Certification of Small Airplanes for Flight in Icing Conditions," U.S.Department of Transportation. Federal Aviation Administration, AC 23.1419-1, September 2, 1986.

1-17 "Airplane Airworthiness Transport Categories," Civil Air Regulation, CARPart 4b, Federal Aviation Agency, Washington, D.C., 1962.

1-18 Bowden, et al., "Engineering Summary of Airframe Icing Technical Data," FAA Technical Report ADS-4, General Dynamics/Convair, SanDiego, California, 1964.

1-19 "Certification of Normal Category Rotorcraft," U.S.Department of Trans-portation, Federal Aviation Administration, AC 27-1, August 29, 1985.

1-20 "Certification of Transport Category Rotorcraft," U.S.Department ofTransportation, Federal Aviation Administration, AC 29-2, May 20, 1983.

1-21 Pfeifer, G.D., et al., "Endineerind Summary of Powerplant Icing Technical Data," FAA Report No.FAA-RD-77-76, July 1977.

1-22 Jones, A.K. and Lewis, William, "Recommended Values of Meteorological Factors to be Considered in the Design of Aircraft Ice-prevention Equipment," NACA TN 1855, March 1949.

1-23 Hacker, P.T. and Dorsch, R.G., "A Summary of Meteorological Conditions Associated With Aircraft Icing and a Proposed Method of Selecting Design Criterions for Ice-Protection Equipment," NACA TN 2569, 1951.

1-24 Bergrun, Norman R. and Lewis, William. . Probability Analysis of the Meteorological Factors Conducive to Aircraft Icing in the United States," NACA TN 2738, 1952.

TABLE 1-1. ICE INGESTION REQUIREMENTS FOR TURBINE ENGINES (REFEFENCE 1-5)

Foreign Object	Test Quantity	Speed of Foreign Object	Engine Operation	Ingestion
Ice	Maximum accumilation on a typical inlet cowl and engine face resulting from a 2-minute delay in actuating anti-icing system, or a slab of ice which is comparable in weight or thickness for that size engine.	Sucked in	Maximum cruise	To simulate a continuous maximum icing encounter at 25°F.

NOTE: The term "inlet area" as used in this section means the engine inlet projected area at the front face of the engine. It includes the projected area of any spinner or bullet nose that is provided.

Pressure altitude range, S.L. to 22,000 Ft.
Maximum vertical extent 6,500 Ft.
Horizontal extent, standard distance of 17.4 nmi

Source: (Reference 1-22)
Class III-M continuous maximum

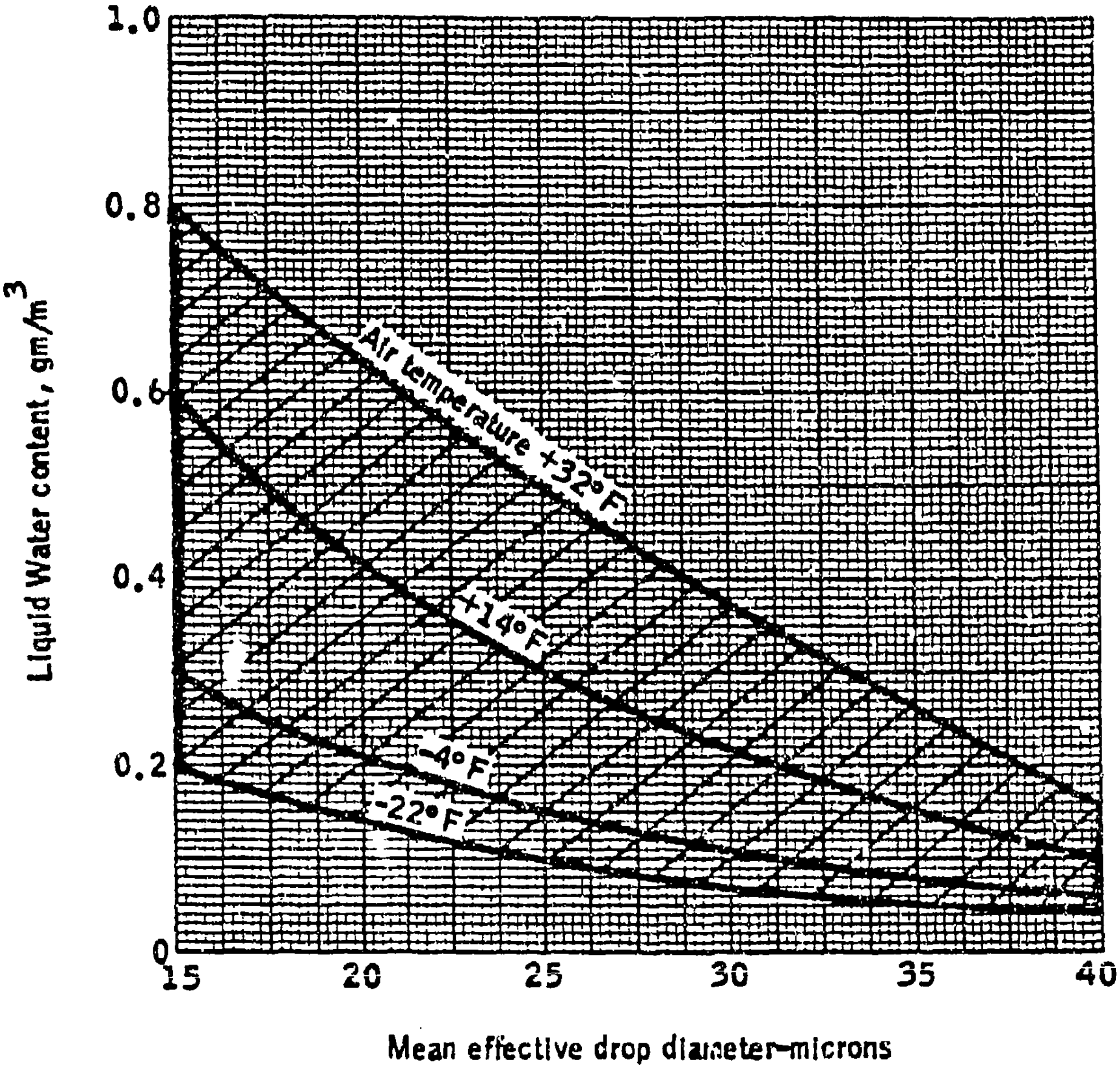

FIGURE 1-1. FAR PART 25 (APPENDIX C) CONTINUOUS MAXIMUM ATMOSPHERIC ICING CONDITIONS (STRATIFORM CLOUDS) - MEAN EFFECTIVE DROPLET DIAMETER VS. LIQUID WATER CONTENT (REFERENCE 1-2)

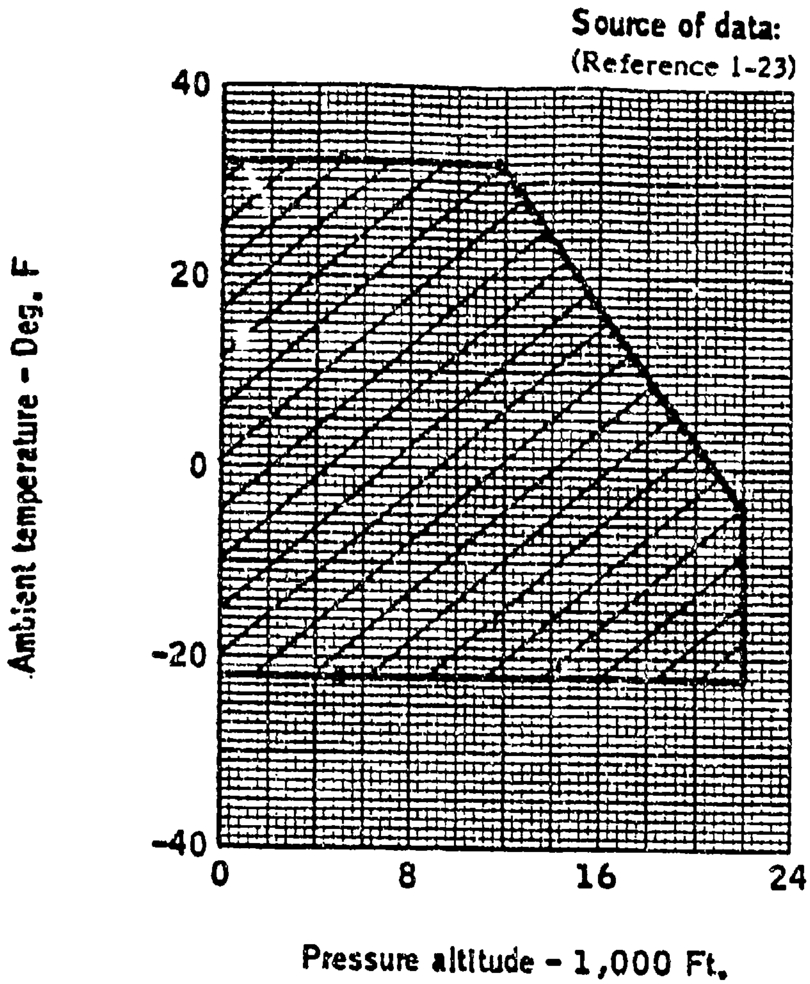

FIGURE 1-2. FAR PART 25 (APPENDIX C) CONTINUOUS MAXIMUM ATMOSPHERIC ICING CONDITIONS (STRATIFORM CLOUDS) - PRESSURE ALTITUDE VS. AMBIENT TEMPERATURE (REFERENCE 1-2)

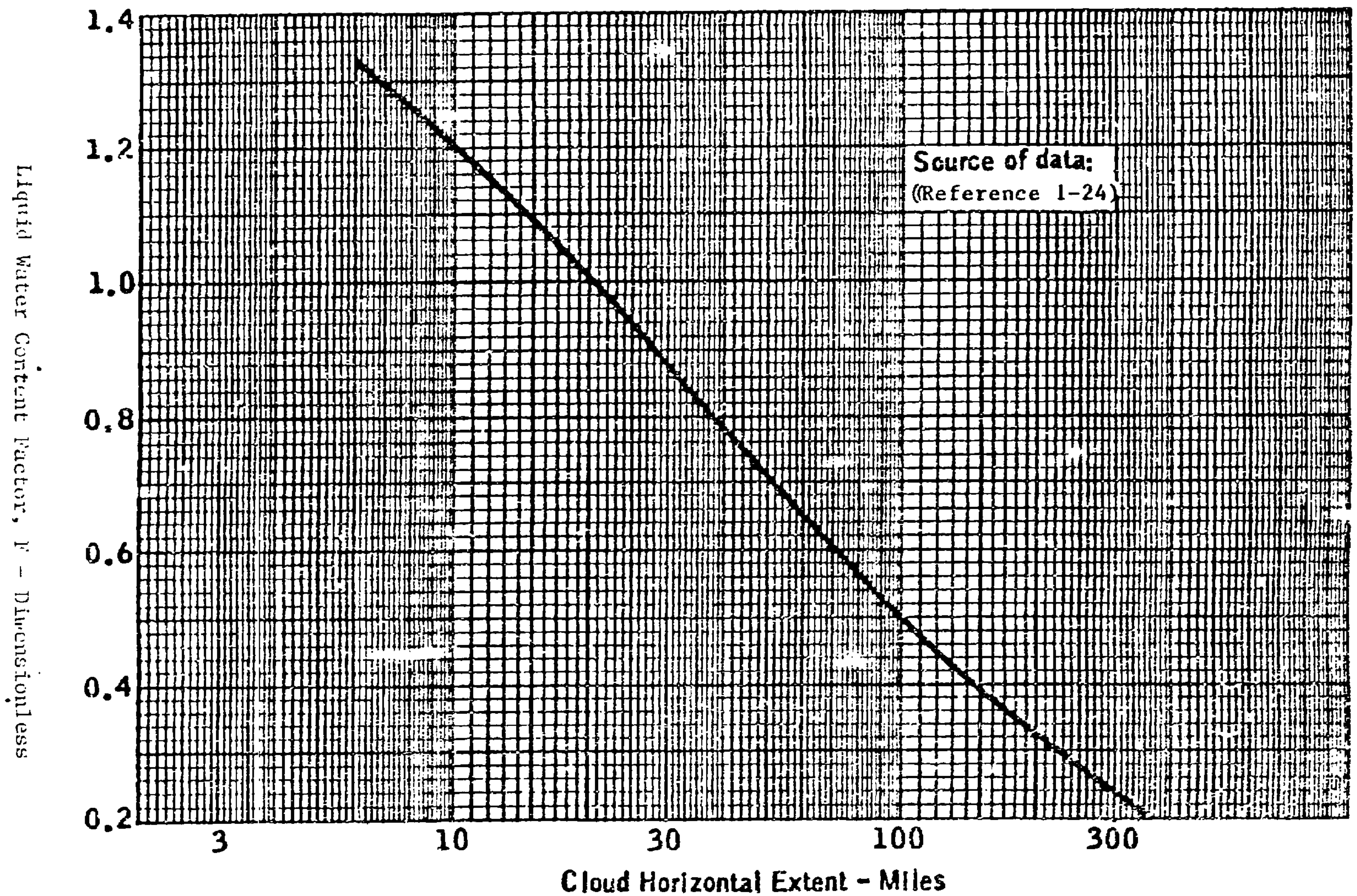

FIGURE 1-3. FAR PART 25 (APPENDIX C) CONTINUOUS MAXIMUM ATMOSPHERIC ICING CONDITIONS (STRATIFORM CLOUDS) - CLOUD HORIZONTAL EXTENT VS. LIQUID WATER CONTENT FACTOR (REFERENCE 1-2)

Pressure altitude range
4,000 to 22,000 Ft.

Horizontal extent, standard
distance of 2.6 Nautical miles

Source of data:
(Reference 1-22)

Note: Dashed lines
indicate possible
extent of limits

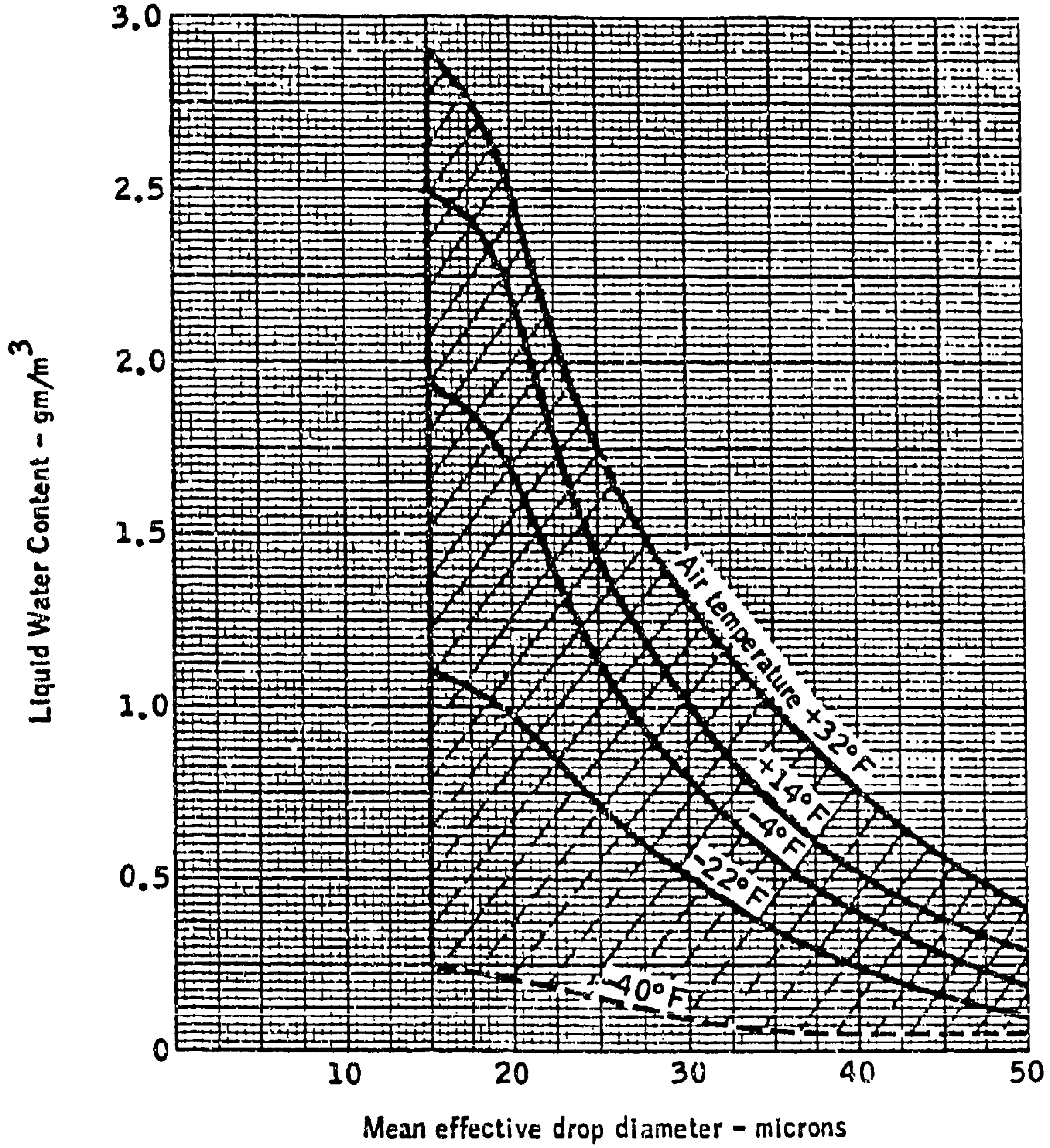

FIGURE 1-4. FAR PART 25 (APPENDIX C) INTERMITTENT MAXIMUM ATMOSPHERIC ICING CONDITIONS (CUMULIFORM CLOUDS) - MEAN EFFECTIVE DROPLET DIAMETER VS. LIQUID WATER CONTENT (REFERENCE 1-2)

Source of data:
(Reference 1-23)

Note: Dashed lines
indicate possible
extent of limits

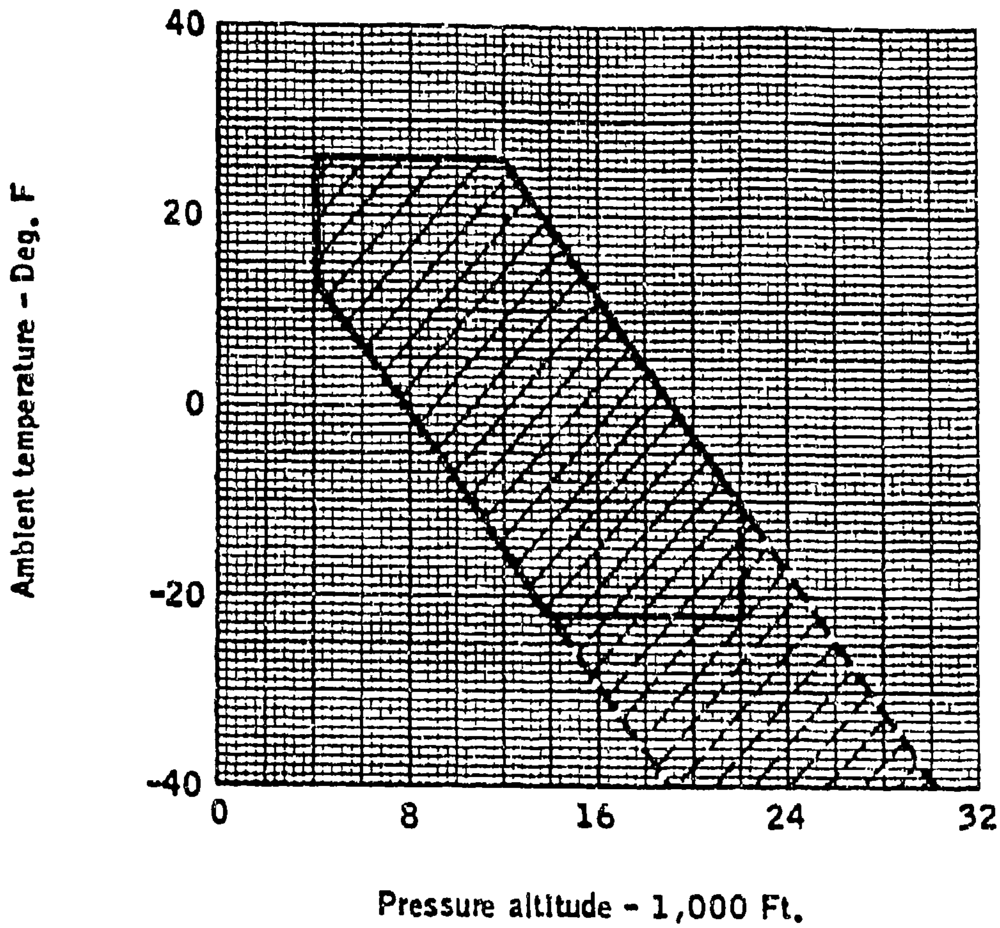

FIGURE 1-5. FAR PART 25 (APPENDIX C) INTERMITTENT MAXIMUM ATMOSPHERIC ICING CONDITIONS (CUMULIFORM CLOUDS) - PRESSURE ALTITUDE VS. AMBIENT TEMPERATURE (REFERENCE 1-2)

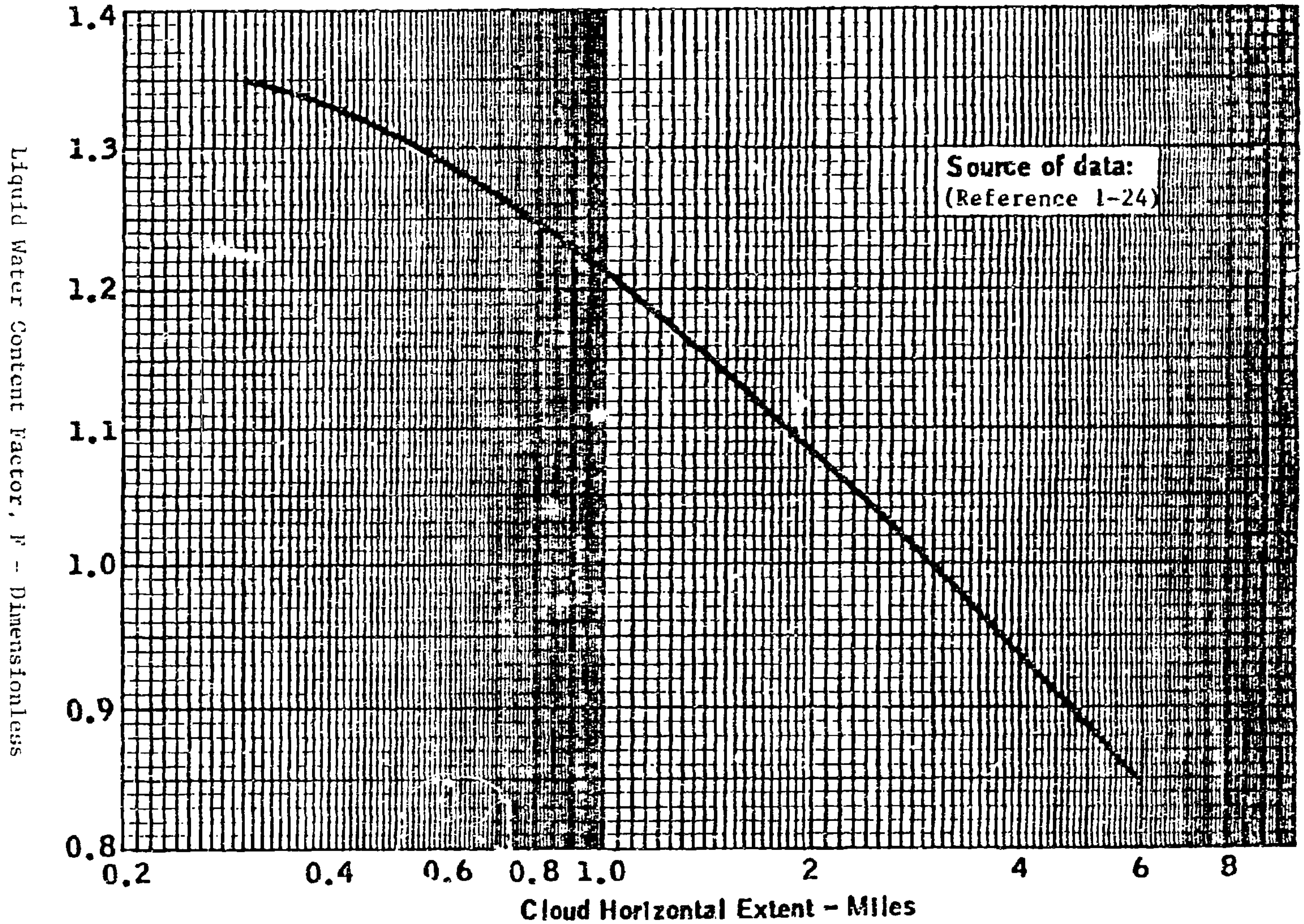

FIGURE 1-6. FAR PART 25 (APPENDIX C) INTERMITTENT MAXIMUM ATMOSPHERIC ICING CONDITIONS (CUMULIFORM CLOUDS) - CLOUD HORIZONTAL EXTENT VS. LIQUID WATER CONTENT FACTOR (REFERENCE 1-2)

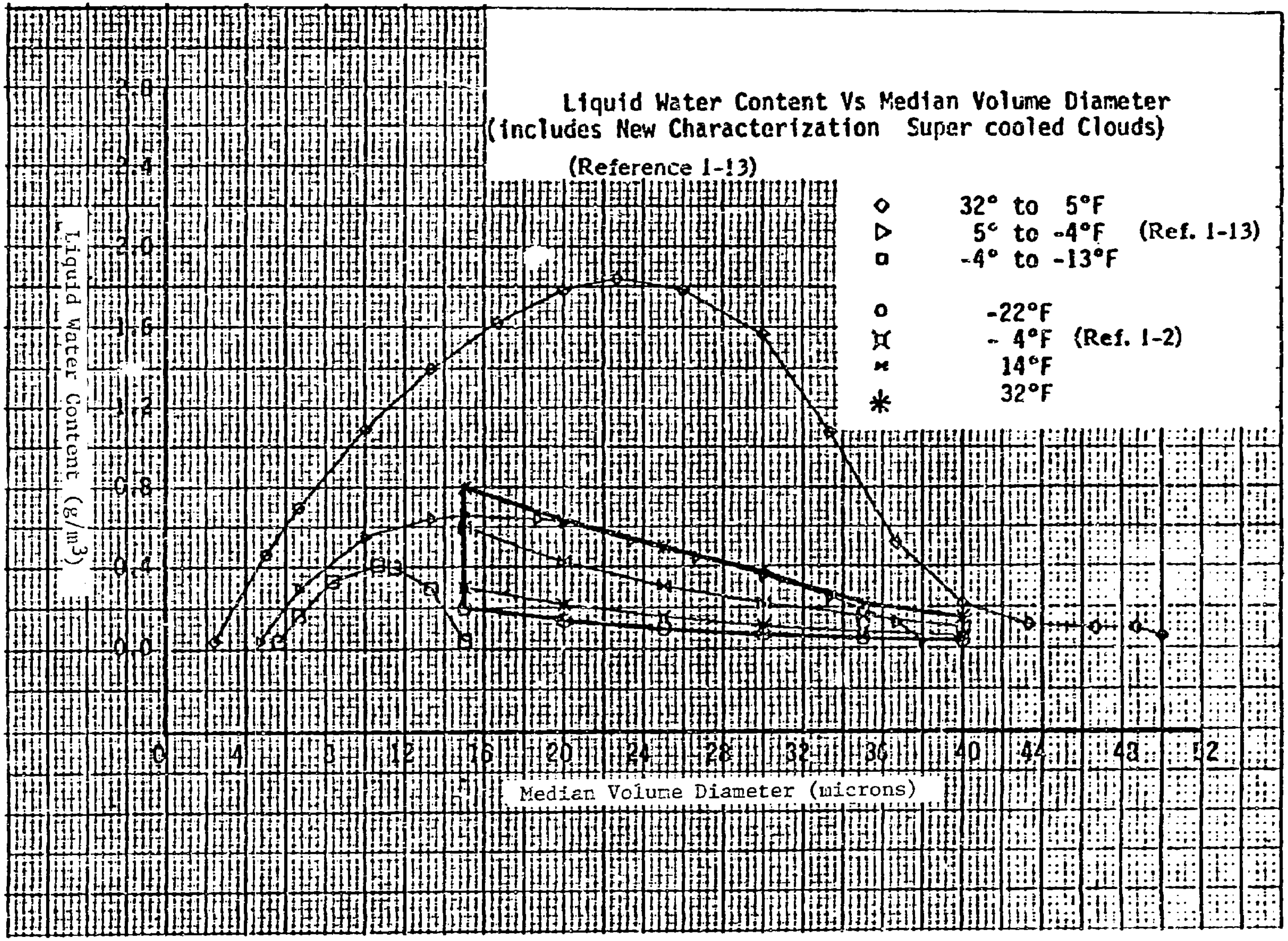

FIGURE 1-7. COMPARISON OF BASELINE ICING CONDITIONS (STRATIFORM CLOUDS)

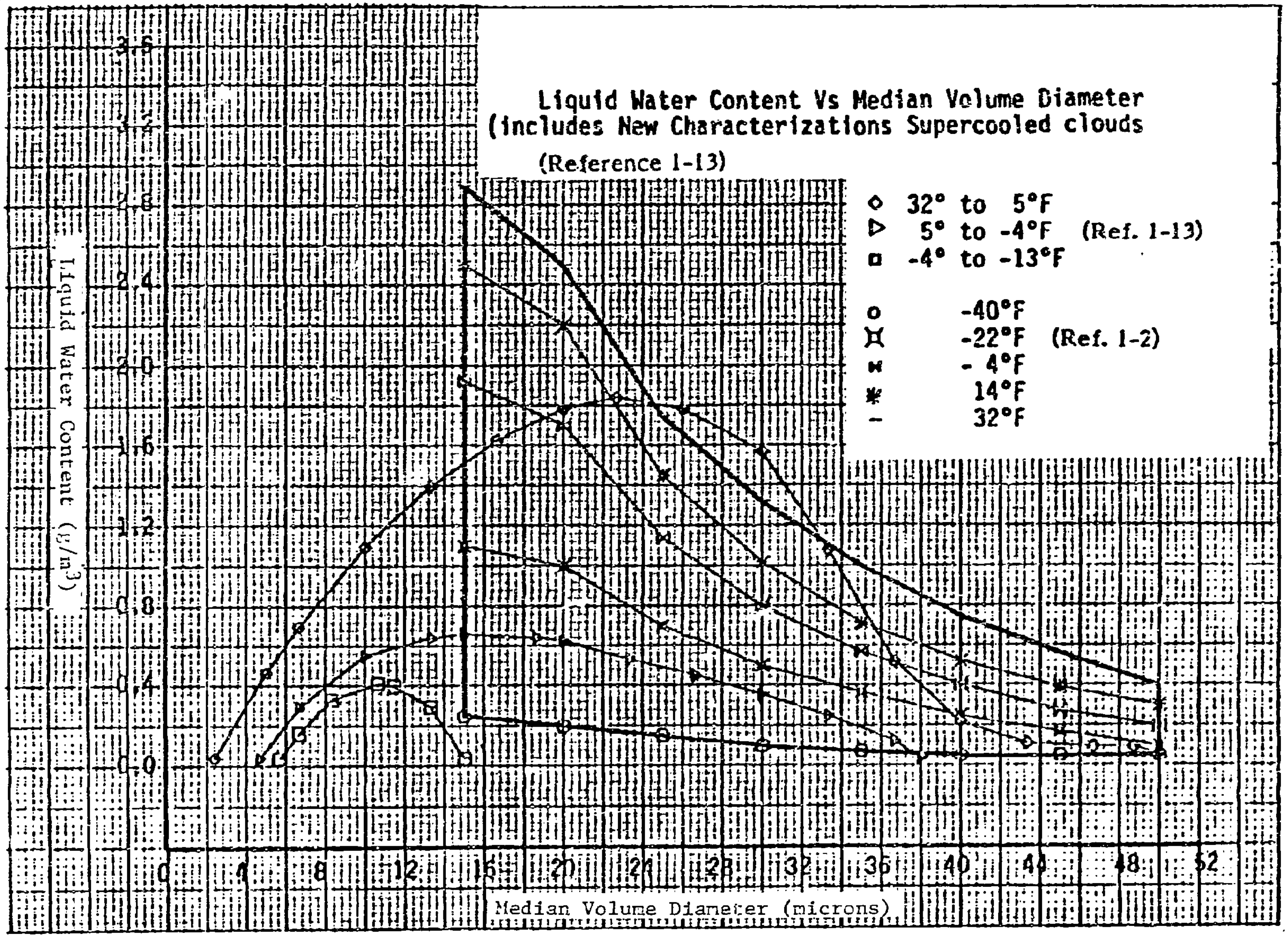

FIGURE 1-8. COMPARISON OF BASELINE ICING CONDITIONS (CUMULIFORM CLOUDS)

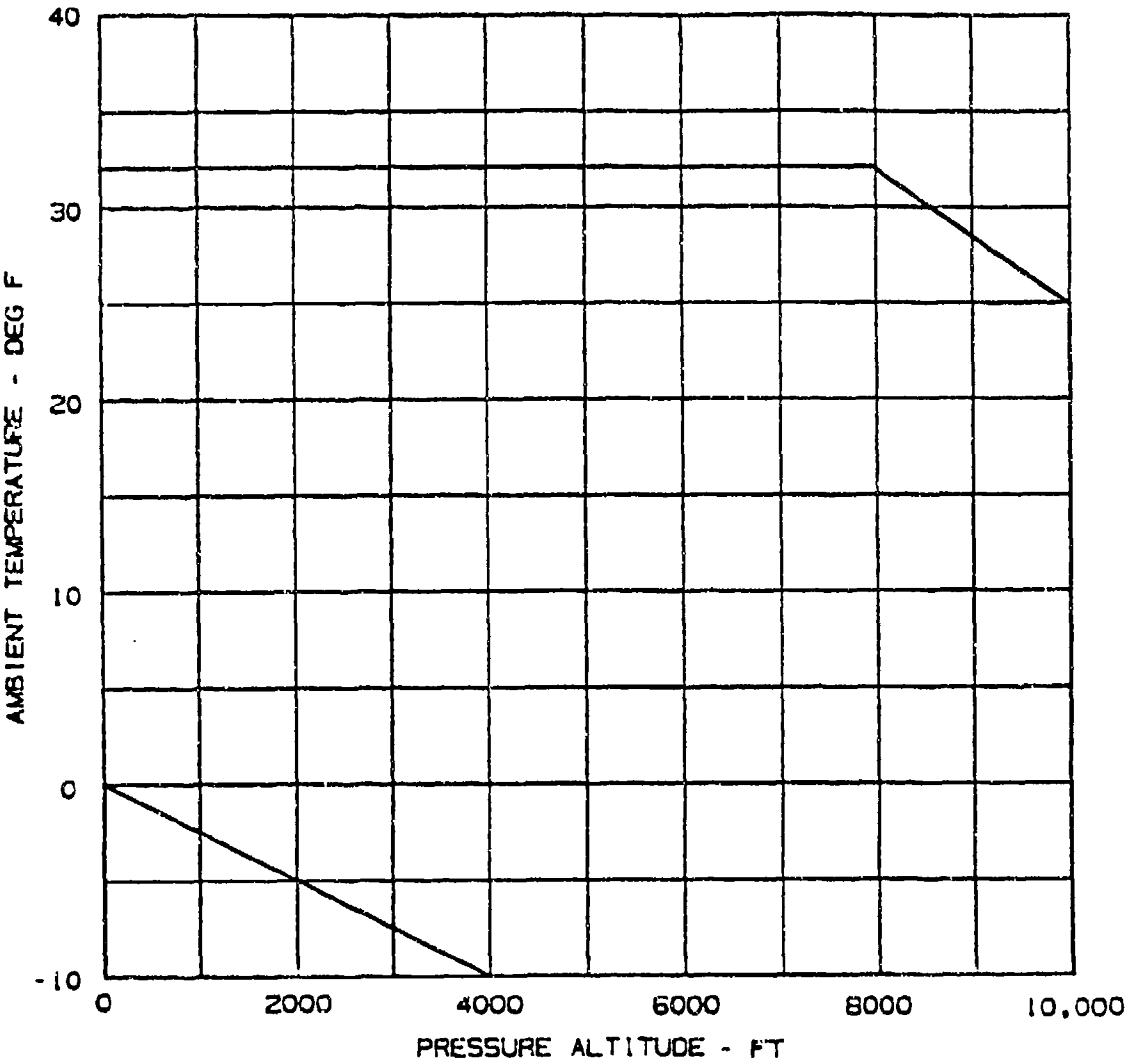

FIGURE 1-9. CONTINUOUS ICING TEMPERATURE VS ALTITUDE LIMITS (REFERENCE 1-20)

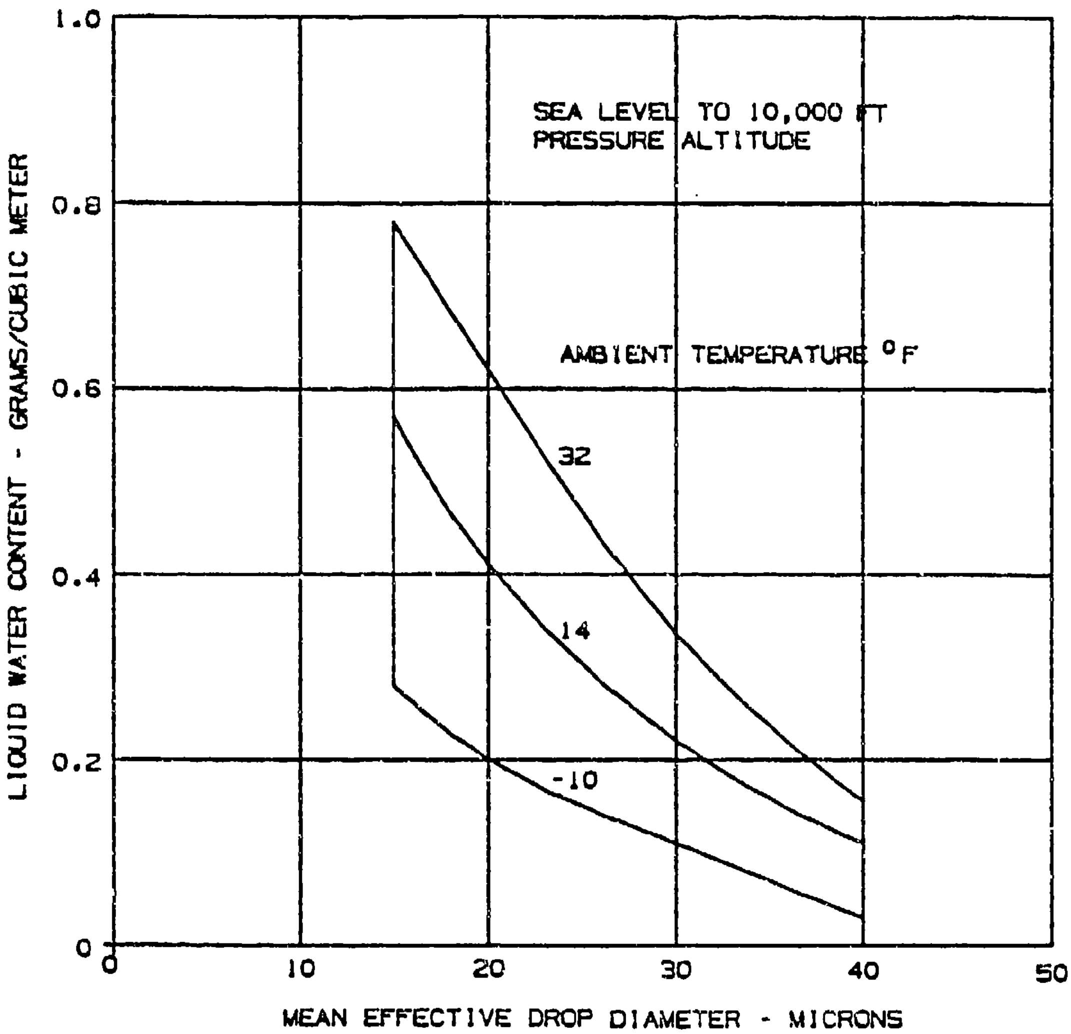

FIGURE 1-10. CONTINUOUS ICING LIQUID WATER CONTENT VS DROP DIAMETER (REFERENCE 1-20)

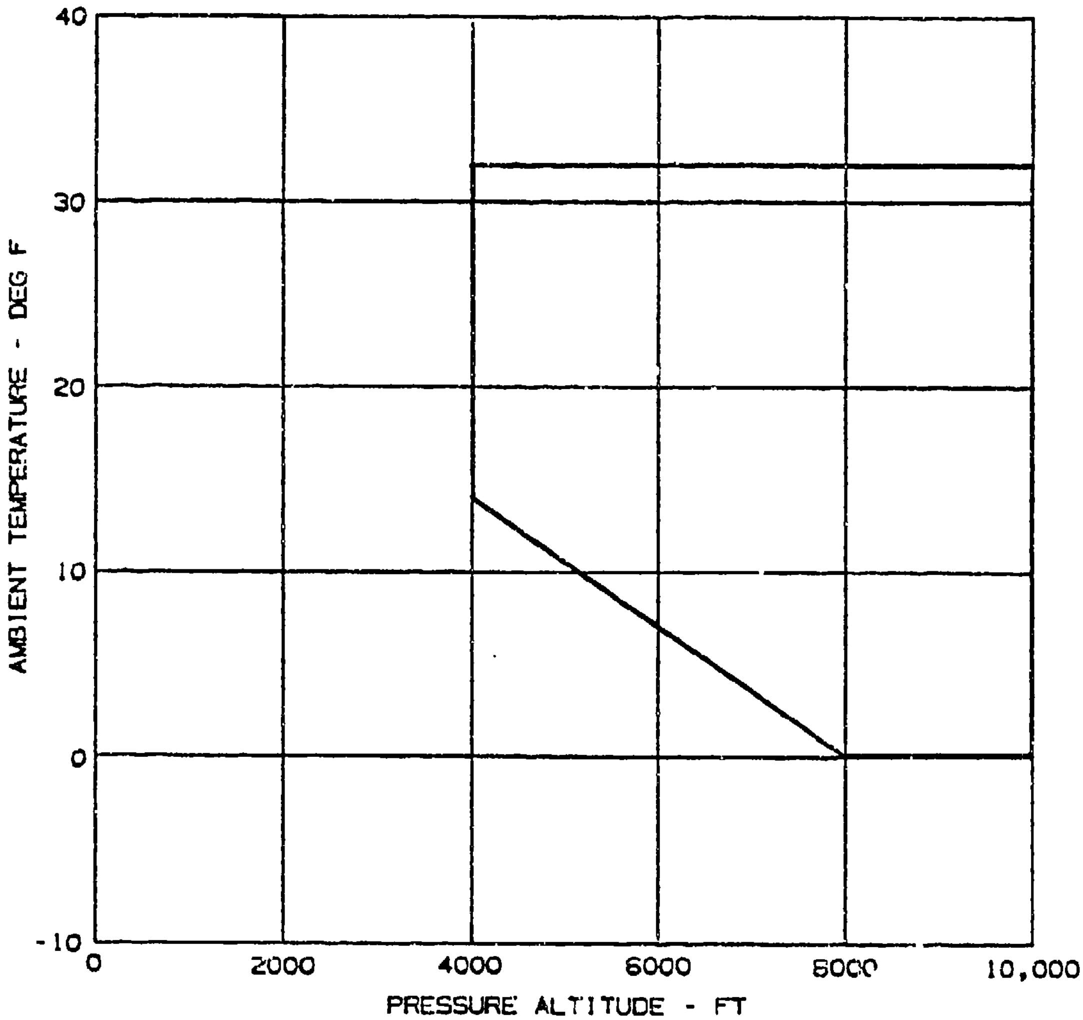

FIGURE 1-11. INTERMITTENT ICING TEMPERATURE VS ALTITUDE LIMITS (REFERENCE 1-20)

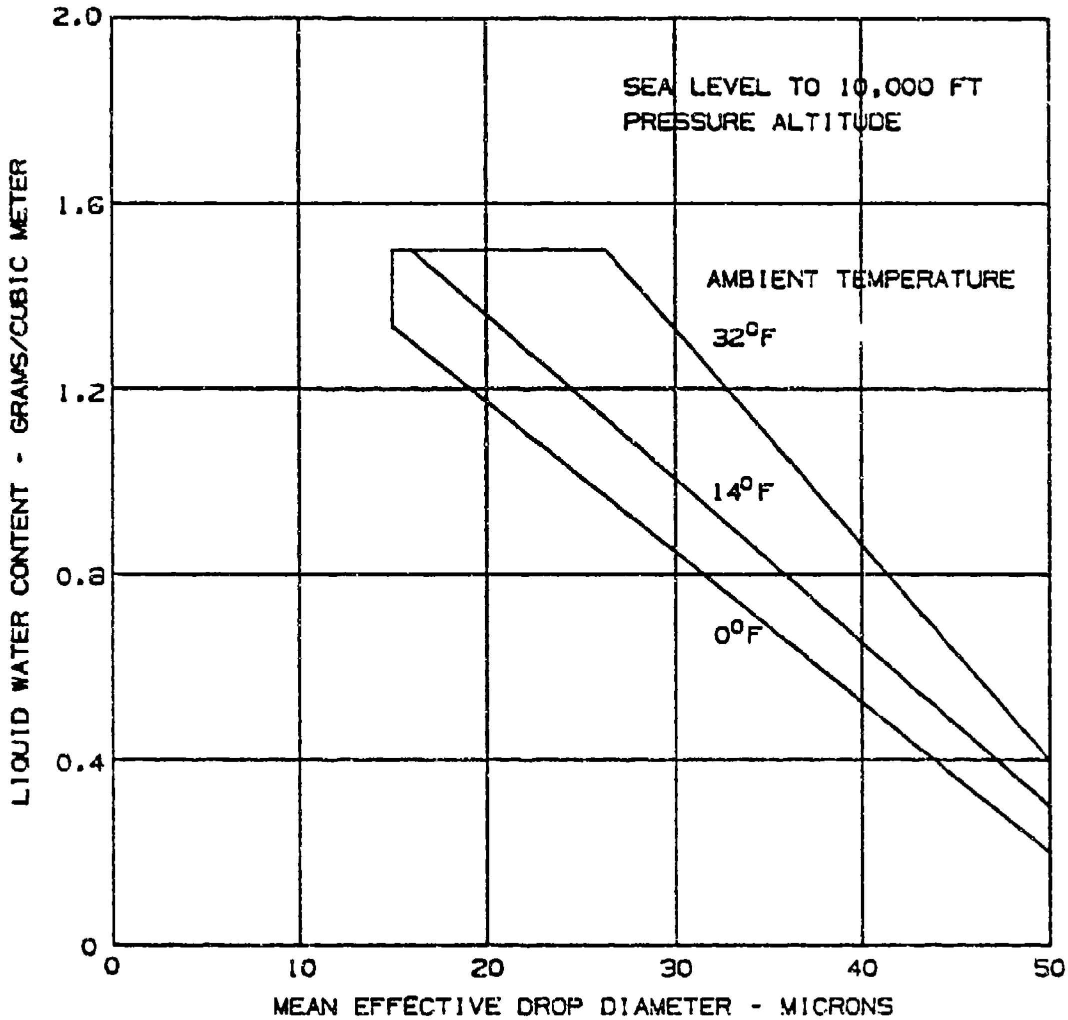

FIGURE 1-12. INTERMITTENT ICING LIQUID WATER CONTENT VS DROP DIAMETER (REFERENCE 1-20)

CHAPTER VI
SECTION 2.0
U.S. MILITARY SPECIFICATIONS

CHAPTER VI

CONTENTS

SECTION 2.0 U.S. MILITARY SPECIFICATIONS

LIST OF TABLES

LIST OF FIGURES

SYMBOLS AND ABBREVIATIOMS

Symbol	Description
A	Total windshield area, square feet
C	Celsius
cm	Centimeter
F	Fahrenheit
g	Grams
Hg	Mercury
hr	hour
k/hr	Kilometers per hour
lb	Pounds weight
LWC	Liquid Water Content m;ieter
MVD	Miedian Volume Diameter
μm	Micron (micro meter)
X	Airplane range in hours

GLOSSARY

liquid water content (LWC) - The total mass of water contained in all the liquid cloud droplets within a unit volume of cloud. Units of LWC are usually grams of water per cubic meter of air (g/m^3).

median volume diameter (MVD) - The droplet diameter which divides the total water volume present in the droplet distribution in half; i.e , half the water volume will be in larger drops and half the volume in smaller drops. The value is obtained by actual drop size measurements.

micron (μm) - One millionth of a meter.

VI.2.0 MILITARY SPECIFICATIONS

VI.2.1 INTRODUCTION

Ice protection systems for military aircraft are normally designed to meet Military Specifications. This section presents a summary and discussion of these specifications as they relate to airframe, engines, windshields/canopies, pitot tubes, and ice detectors. Although aircraft originally developed for the military are governed by these specifications, military use of aircraft certified to civilian regulations is common. In the latter case, the military accepts certification to Federal Aviation Regulations of the U.S. Department of Transportation. Recent examples of military purchase or lease and operation of non-military certified aircraft are the C-21A (Gates Learjet Corporation Model 35A aircraft certified to FAR Part 25), the C-12A (Beech Aircraft Company King Air Model 200 aircraft certified to FAR Part 23), and the T-47 (Cessna Aircraft Company Citation Model 552 aircraft certified to FAR Part 25).

Military certification for flight in icing conditions involves considerations similar to that for civilian aircraft of meteorological atmospheric characteristics and ice protection systems. For military aircraft, however, if the operational speed is on the order of 450 knots (830 k/hr) or more (figure 2-1), ice protection is usually not required except for loiter, landing, or takeoff. The design icing conditions for the airframe are 15°F (-9.4°C) or less, liquid water content (LWC) of 0.5 g/m^3, and droplet mean volumetric diameter (MVD) of 20 microns. Military specifications are discussed in the following paragraphs for pneumatic boot and heated surface type systems.

VI.2.2 AIRFRAME

The ice protection system is intended to protect the aircraft surfaces against ice accumulation. Portions of the wing and empennage surfaces which are exposed to ice accretion during flight in icing conditions may require protection by an acceptable system. Current specifications cover two types of airfoil surface ice protection systems; namely, pneumatic boots and heated surface type systems as discussed in the following paragraphs.

2.2.1 Pneumatic Boot System

Specification MIL-D-8804A (reference 2-1) covers the general requirements for pneumatic boot de-icing systems for wings, empennage, radome, air inlets, and etc. The system consists of the following components: de-icing boots, air and vacuum sources, valves, pressure regulator, safety valve, oil separator (if required), timer, test connections, and gages. The pneumatic boot de-icing system should be capable of removing accreted ice from all aircraft surfaces under the specified design icing conditions.

System controls should be provided for symmetrical operation of the boots. The predetermined inflation pressure will be regulated to vary not more than ±0.5 lb/in^2. The vacuum relief valve will be provided to regulate the vacuum pressure to ±0.5 inches of Hg of the design value when the engine

is operating at takeoff RPM. Satisfactory operation is required with the aircraft at rest, taxiing, takeoff, in flight, and during landing. The boots, when operating, should not appreciably affect the aircraft stall characteristics.

System ground tests should be conducted with the aircraft at rest using an inflation pressure of 15 to 22 lb/in^2 and a deflation suction of at least 4 inches of Hg to demonstrate the general operation and safety of the system for flight test. The system should be checked for leaks during these ground tests with a pressure decrease of not more than 5 lb/in^2 in one minute.

Flight tests are conducted to evaluate the effect of the boot system operation on performance and handling characteristics of the aircraft.

2.2.2 Heated Surface Type Ice Protection (MIL-A-9482) (Reference 2-2)

This specification covers the requirements for airframe thermal ice protection systems, excluding engine air-induction systems and radomes. Some areas to be protected by heated surface type systems are:

a. Portions of the wings and empennage surfaces which are exposed to ice accumulations during flight under the specified icing conditions.
b. Antenna masts, hinge fairings, spoilers, dive brakes, struts, and other miscellaneous ice accreting components whose ice protection needs will be decided based on the effect of ice accumulation on the normal functions of the individual component and the associated increase in drag on the aircraft performance.
c. Transparent areas (see also Section 2.5).
d. Entrance to each air scoop that must function during icing conditions.
e. Guide vanes or at abrupt changes in direction of ducts leading from air scoops to permit unrestricted flow in these ducts.

The design conditions for evaporative anti-icing heated surface type systems are an ambient temperature of 15°F (-9.4°C), liquid water content (LWC) of 0.5 g/m^3, and a droplet mean volumetric diameter (MVD) of 20 microns. Duration, or horizontal extent, of the icing condition is not specified. These values will be used in the design of evaporative thermal ice protection systems and are similar to the maximum continuous icing conditions specified by the FAA regulations (reference 2-3). If the aircraft design mission requires intermittent operation below 20,000 feet (6100 m) (e.g., low level reconnaissance, attack, or refueling), typical operating conditions should include the high and low speed extremes.

The following procedures are recommended for computing the heat required and available for the heated surface type protection system. The amount and chordwise extent of droplet impingement are determined by droplet trajectory studies (Section 2.3) for the airfoil sections used and corrected for sweep angle. External heat transfer coefficients are based on the transition from laminar to turbulent flow at the aft edge of the impingement area. The impingement area is considered to be

completely wet, while areas aft of the impingement area are considered to be 20 percent wet. Water evaporation is determined from integration of point evaporation rates and will be based on average skin temperatures. Heat requirements are determined at the root, tip, and at an intermediate span section of the wing.

The primary heat source is hot air from compressor bleed, exhaust gas heat exchangers, or combustion heaters. Electrical heating may be used for small areas where it is more convenient or where it induces less penalties to the airplane performance. Detail design includes material specification and precautions. Since aluminum alloy structural members are heated by the ice protection system, allowance must be made for the reduction in allowable stress. If the heating air contains exhaust products, stainless steel or other corrosion resistant material should be used in the construction. Distribution ducts should be insulated to reduce heat losses. All system components should have a minimum life of 500 hours.

Prior to ice protection system installation in an airplane, the manufacturer is normally required to submit to the procuring activity the following:

a. System design report describing the system with complete data on heat requirements and heat available.

b. System test report on all items of equipment used in the system to demonstrate compliance with test requirements.

c. Instrumentation report outlining in detail the proposed instrument installation, methods of calibration, and sufficient description to indicate the location and significance of each item.

d. Test plan report outlining tests to be conducted, data to be obtained, and the purpose of the tests.

e. Final report that includes an evaluation and extrapolation of the data to design conditions.

Final approval of the ice protection system is contingent on clear indication of intended function performance and satisfactory submission of the test data. The ground and flight tests specified below is typical of those conducted on an airplane designated by the procuring activity, so as to demonstrate compliance of the ice protection equipment. Whenever possible, the manufacturer is encouraged to conduct the ground tests on ground mock-ups to preclude any damage to the airplane in case of system malfunction and to ensure early detection of deficiencies. Ground tests are conducted to demonstrate control system operation, temperature indication system operation, overheat warning and control operation, general security and safety of the system for flight testing, distribution of available airflow, and freedom from overheating and detrimental effects of differential expansion.

Flight tests in dry air will provide a complete thermal survey to determine the heat available. These tests should be conducted in sufficient detail and accuracy to permit the extrapolation of results to actual icing conditions. Suggested flight conditions are:

1. Normal takeoff and climb to operating altitude.
2. Normal descent and landing.

3. Level flight at speed for maximum endurance, maximum speed, and an intermediate speed approximately half-way between these speeds at 5,000, 10,000, and 20,000 feet (1500, 3050, and 6100 m) altitudes.

Sufficient instrumentation is required to determine the quantity and the temperature of air from each heat source and the quantity and temperature of airflow in all main distribution ducts. Sufficient structural temperatures must be measured to ensure structural overheating does not occur.

VI.2.3 ENGINES (MIL-E-5007) (Reference 2-4)

This specification establishes the performance, operating characteristics, and design features for turbojet and turbofan engines. The engine must operate satisfactorily under icing conditions that are similar to the FAA requirements for continuous and intermittent maximum icing conditions (reference 2-3), with not more than 5 percent total loss in thrust available and not more than 5 percent total increase in specific fuel consumption at all operating conditions above 50 percent maximum continuous power setting. If ice protection is required, the system should prevent ice accumulation on any part of the engine while operating under the specified icing conditions. The engine should be capable of ingesting hail and any ice sheet of 3 x 9 x 0.25 inch (7.6 x 23 x 0.64 cm) which accretes on the engine inlet or duct without flame-out, lengthy power recovery, or critical engine failure.

For a hot air ice protection system, continuous operation of the system throughout the airplane operating envelope should not damage the engine. For electro-thermal ice protection systems, the engine should be capable of simultaneous operation of the ice protection system and all other engine electrical systems.

Environmental icing tests should demonstrate compliance while operating in the specified icing conditions. For this testing, the engine will be operated under the ambient air conditions listed in table 2-1 For each test run the liquid water content (LWC) and droplet size (MVD) will be measured at a distance within 5 feet (1.5 m) of the engine inlet face and still within the inlet duct. During testing, engine thrust, RPM, and vibration will be continuously recorded and high speed photographic coverage of the engine inlet provided. The baseline for determining engine performance loss is established by operating the engine with no air bleed or electrical power extraction for ice protection operation and under the inlet temperature conditions of table 2-1 With ambient air between 80 and 100 percent relative humidity. The thrust/power and specific fuel consumption penalties for ice protection are determined by comparison with engine performance when operating in icing conditions at the same baseline values.

Testing will be considered satisfactorily completed when, in the judgement of the procuring service, there was no damage to the engine and performance was maintained within specified limits.

The engine will also be subjected to an ice ingestion test. The type of ice and conditions for ingestion are stated as follows:

a. One 2 inch (5 cm) diameter hailstone and two 1 inch (2.5 cm) diameter hailstones of 0.8 to 0.9 specific gravity for each 400 square inches (0.26 m^2) of inlet area at the engine face at typical takeoff, cruise, and descent power conditions.

b. Sheet ice in typical sizes, forms, and thicknesses representative of that which would accrete in the inlet duct and/or on the inlet lip in quantities likely to be ingested during takeoff and cruise conditions.

VI.2.4 PROPELLERS (MIL-P-26366A) (Reference 2-5)

This specification covers the standard requirements and tests for aircraft propeller systems. The propeller should have an ice protection system for blades, cuffs, and the spinner. Either electrical, fluid, hot air, compound, or mechanical ice protection system or combination of two or more such systems may be used when approved by the procuring service. The design icing conditions are:

Condition 1
LWC of 1 g/m^3
Air temperature of -4°F (-20°C)
MVD of 15 microns
Condition 2
LWC of 2 g/m^3
Air temperature of 23°F (-5°C)
MVD of 25 microns

Both conditions are tested at sea level static conditions.

VI.2.5 WINDSHIELDS AND CANOPIES (MIL-T-5842B) (Reference 2-6)

This specification establishes the requirements for systems which protect transparent areas on aircraft surfaces (windshields and canopies) from ice accretion, frost, moisture, and snow. The ice protection system may be designed to function by means of hot air, electrical conductive coatings, liquid spray, infrared radiation, or a suitable method approved by the procuring service. Where applicable, aerodynamic heating may be included in the thermal analysis. The design environment for windshields and canopies is similar to FAR part 25 appendix c.

2.5.1 Windshield Spray Equipment (MIL-S-6625A) (Reference 2-7)

This specification covers a type of spray equipment for the protection from ice formation on aircraft transparencies. This equipment consists of a spray tube, fluid pump, fluid tank, and a control valve. The fluid pump is an electrically driven unit with automatic pressure control. The pump

should have a capacity to supply 2 quarts (1.9 liter) of fluid per square foot/hour for 2/3 of the window area. The fluid storage capacity should be (0.74 A x/12) gallons, where A is the total area of the windshield in square feet, and x is the airplane range in hours with full military load and the pressure in the storage tank is 4 lb/in^2.

The fluid employed is isopropyl alcohol. The system is expected to function satisfactorily at all temperatures from 120 to -65°F (49 to -54°C) and at all altitudes from sea level to 25,000 feet (7600 m) and not be damaged when exposed to a temperature of 160°F (71°C) for 48 hours.

VI.2.6 ELECTRICALLY HEATED PITOT TUBE (MIL-T-5421B) (Reference 2-8)

This specification covers all types of two-wire electrically heated pitot tubes. Pitot tubes should be tested in an icing wind tunnel at an indicated airspeed of 100 knots (185 k/hr) and an ambient temperature of 5°F ±9°F (-15°C ±5°C). The nose of the pitot tube will be coated with an ice cap approximately 0.25 inch thick (0.64 cm) and then the applicable voltage should be applied. The time required to clear the ice-cap after the voltage is applied should not be more than 2 minutes. The tube is also subjected to a temperature of -5°F for 48 hours after which there should not be any evidence of damage.

VI.2.7 AIR INTAKE DUCT ICE DETECTOR (MIL-D-8181B) (Reference 2-9)

This specification establishes requirements for ice detectors. The ice detector system is designed to

a. Operate a warning device to indicate to the pilot when dangerous icing conditions are encountered.

b. Transmit an electrical signal which can be used to actuate the ice protection system.

c. Sense accumulating ice throughout a temperature range of -65 to 45°F (-54 to 7°C).

VI.2.8 REFERENCES

2-1 "De-Icing Systems, Pneumatic Boot, Aircraft, General Specification for,"MIL-D-8804A, 26 September 1958.

2-2 "Anti-Icing Equipment for Aircraft, Heated Surface Type, General Specifi-cation for," MIL-A-9842(AV), 2 April 1981.

2-3 "Airworthiness Standards: Transport Category Airplanes," Federal Aviation Regulations, FAR Part 25, U.S. Department of Transportation, Federal Aviation Administration, Washington, D.C., 1986.

2-4 "Engine, Aircraft, Turbojet and Turbofan, General Specification for,"MIL-E-5007D, Amendment 2, 8 October 1982.

2-5 "Propeller Systems, Aircraft, General Specification for," MIL-P-26366A,Amendment 2, 22 May 1984.

2-6 "Transparent Areas on Aircraft Surfaces (Windshields and Canopies), Rain Removing and Washing Systems for, Defrosting, De-Icing, Defogging, General Specification for," MIL-T-5842B(AS), 29 March 1985.

2-7 "Spray Equipment, Aircraft Windshield, Anti-Icing," MIL-S-6625A(ASG), 26 March 1953.

2-8 "Tubes, Pitot, Electrically Heated, Aircraft," MIL-T-5421B, Amendment 2,19 June 1985.

2-9 "Detector, Ice, Air Intake Duct, Aircraft Engines and Airframe Systems, General Specification for," MIL-D-8181B(ASG), 15 March 1965.

TABLE 2.1. SEA LEVEL ENGINE ICING CONDITIONS (Reference 2-4)

	Part 1			Part 2
Engine Inlet Total Temp.	-4°F(-20°C)±1°	+15°F(-10°C)±1° (1)	+23°F(-5°C)±1°	+23°F(-5°C)±1°
Velocity	0 to 60 knots	0 to 60 knots	0 to 60 knots	0 to 60 knots
Altitude	0 to 500 ft (0 to 150 m)	0 to 500 ft (0 to 150 m)	0 to 500 ft (0 to 150 m)	0 to 500 ft (0 to 150 m)
Mean Effective Drop Diameter	20 microns	20 microns	20 microns	20 microns
Liquid Water Content (Continuous)	1 g/m^3 ±0.25 g/m^3	2 g/m^3 ±0.25 g/m^3	2 g/m^3 ±0.25 g/m^3	0.4 g/m^3 ±0.1 g/m^3

(1) This condition is deleted for non-fan engines.

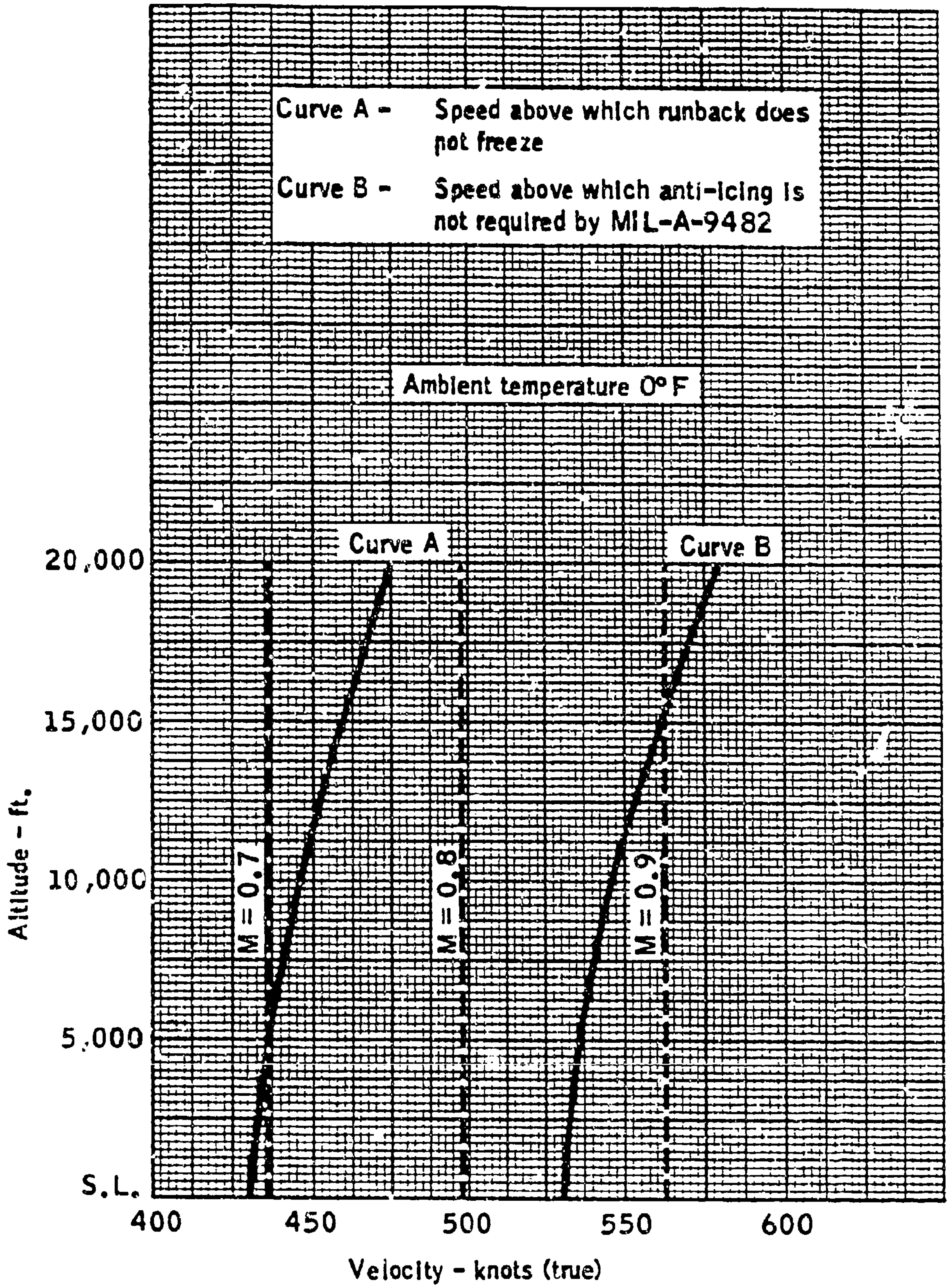

FIGURE 2-1. EFFECT OF SPEED UPON REQUIREMENTS FOR ANTI-ICING (REFERENCE 2-2)

CHAPTER VI
SECTION 3.0
FOREIGN REGULATIONS

CHAPTER VI

CONTENTS

SECTION 3.0 FOREIGN REGULATIONS

LIST OF TABLES

LIST OF FIGURES

SYMBOLS AND ABBREVIATIONS

Symbol	Description
AC	Advisory Circular
APU	Auxiliary Power Unit
AWO	All Weather Operation
BAA	Bilateral Airworthiness Agreement
BCAR	British Civil Airworthiness Requirement
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
g	Gram
GATT	General Agreement on Tariffs and Trade
JAR	Joint Airworthiness Requirement
LWC	Liquid Water Content
m	Meter
MVD	Median Volumetric Diameter
TSO	Technical Standard Order
μm	Micron (micro meter)
USSR	United Soviet Socialist Republic

GLOSSARY

liquid water content (LWC) - The total mass of water contained in all the liquid cloud droplets within a unit volume of cloud. Units of LWC are usually grams of water per cubic meter of air (g/m^3).

median volume diameter (MVD) - The droplet diameter which divides the total water volume present in the droplet distribution in half; i .e., half the water volume will be in larger drops and half the volume in smaller drops. The value is obtained by actual drop size measurements.

micron (μm) - One millionth of a meter.

VI.3.0 FOREIGN REGULATIONS

VI.3.1 INTRODUCTION

The Federal Aviation Administration has established various agreements with other nations to permit certification of aircraft imported from one nation to another. The general regulations for exporting aircraft and components from the U.S. are given in Federal Aviation Regulations (FAR) Part 21 (reference 3-1), Subpart L (which includes Sections 21.321 through 21.339).

Additional assistance is available in FAA Advisory Circular AC 21-2F (reference 3-2), "Export Airworthiness Approval Procedures," dated August 1987. This contains special requirements that have been submitted to the FAA by 39 foreign governments, indicated by "S" in table 3-1. Samples of export airworthiness forms are included in AC 21-2E. Advisory Circular AC 21-7A (reference 3-3) deals with the certification of aircraft, propellers, and related products being imported into the United States.

Twenty-four nations have agreements with the United States which are known as Bilateral Airworthiness Agreements (BAA). These are "Executive Agreements" concluded at the government-to-government level by exchange of diplomatic notes, with an appropriate State Department official signing for the United States. Advisory Circular 21-18 (reference 3-4), "Bilateral Airworthiness Agreements," contains copies of the BAAs. The BAAs are not considered to be Trade Agreements; rather, they are technical agreements, intended to facilitate the reciprocal acceptance of test results, certificates, or marks of conformity issued by the exporting country. Bilateral Airworthiness Agreements are currently in effect between the United States and the countries indicated by "B" in table 3-1.

A document entitled "Export/Import Airworthiness Certification of Civil Aeronautical Products" (reference 3-5) was issued in 1982 by the FAA Office of Airworthiness. The purpose was to provide assistance in understanding a number of international certification issues. This document discusses the BAAs, their implementation, and their relationship with international conventions and trade agreements to which the United States is signatory, including those under the General Agreement on Tariffs and Trade (GATT).

The addresses of the civil aeronautical authorities in all of these countries are given in AC 21-18 (reference 3-4). Cable addresses and some telephone numbers are also given.

FAA regional offices are assigned responsibility for civil aviation matters in foreign countries as follows:

(a)	Canada	FAA Federal Building John F.Kennedy International Airport Jamaica, N.Y.11430
(b)	Caribbean Area, South America, Central America, Panama, and Canal Zone	FAA, P.O.Box 20636 Atlanta, Georgia 30320
(c)	Mexico	FAA, P.O.Box 1660, Ft.Worth, Texas 76101
(d)	Area East of Bangladesh and India, Including All Free Nations South and East of China	FAA, P.O.Box 50109 Honolulu, Hawaii 96850
(e)	Europe, Africa, Middle-East West of Burma, Iceland, Green- land, and Bermuda	FAA, Rue de Loi, 15, B-1000 Brussels, Belgium

In this chapter, certification requirements applying to aircraft icing flight will be summarized. To a great degree, the FAR's have been accepted as the basic standard in most of the world. Many of the regulations described in this section are in the form of variations from the United States Federal Aviation Regulations in Parts 23, 25, 27, 29, or 33 (references 3-6 through 3-10).

VI.3.2 BRITISH CIVIL AIRCRAFT REGULATIONS (BCAR)

The certification of aircraft in Great Britain is the responsibility of the Civil Aviation Authority and its Air Registry Board. The regulations are known as British Civil Airworthiness Requirements (reference 3-11) or BCARs. Copies of BCAR Sections and Amendments are available from:

Civil Aviation Authority
Printing and Publishing Services
Greville House, 37 Gratton Road
Cheltenham, Glos. GL 50 2 BN
England

Inquiries about the technical content of BCARs should be addressed to:

Civil Aviation Authority
Airworthiness Division
Barbazon House
Redhill, Surrey RH 1 1SQ
England

The ECAR's are being replaced by the Joint Airworthiness Requirements (JAR) (see Section 3.3), but much of the JAR are based on sections of BCAR. This process is evolutionary, with JAR Sections replacing BCAR Sections one by one as the JAR sections become established. For aircraft certified under a BCAR Section these regulations will continue to be applied for all derivative models and modifications. For this reason, a short summary of Chapter D1, 4 and 5 (reference 3-11), the main BCAR Sections concerned with icing flight, will be described below. A status listing (as of 1 April 1986) of sections relevant to icing flight certification is shown as follows:

Section	Subject	Latest Revision
A	Certification and Approval Procedures (CAP 460)	1 September 1985
[C	Engines and Propellers (CAP 462), was replaced by JAR-E and JAR-P on 1 January 1984. JAR-P is not yet in final form and Section C, Issue 13, of BCAR is needed for a complete text.]	
[D	Large Aeroplanes, was replaced by JAR-25 on 1 July 1979.]	
G	Rotorcraft (CAP 465)	16 August 1982
K	Light Aeroplanes (CAP 467)	10 April 1974
JAR-25	Large Aeroplanes	17 March 1986
JAR-AWO	All Weather Operations	19 November 1985
JAR-E	Engines	24 January 1986
JAR-P	Propellers	28 August 1981

Procedures for certification of foreign-constructed aircraft are in sections A2 and A4 (reference 3-11 or 3-12).

Chapter DI, 4, and 5 Comments (Applied prior to 1 July, 1979)

The meteorological criteria used for the British Civil Airworthiness Requirements differ from the U.S. FAR's as follows. For continuous maximum icing conditions (reference 3-11, D-1.5.1(a)) the LWC values for 20 micron MVD are the same as the FAR values for 15 microns, which indicates that the British specify only the 20 micron condition to be met while FAA requires the envelope of LWC and MVD shown in FAR Part 25, Appendix C (reference 3-7), and presented here in Chapter I, figure 3-2 (heavy lines). On the other hand, the BCAR assumes a continuous condition "to be encountered for an unlimited distance" while the FAA defines a standard distance as 20 statute miles (17.4 nm) and gives a multiplying factor for LWC greater or less than the 20 mile standard (Chapter I, figure 3-8).

For intermittent icing conditions, the BCAR maximum condition (reference 3-11, D-1.b.1(b)) is identical to that of the FAR Part 25, Appendix C (reference 3-7), if MVD is 20 microns for both. Again, the British use 20 microns only for the required condition while the FAA has a LWC versus MVD envelope (Chapter I, figure 3-3, heavy lines). The definition of intermittent conditions are different. The FAA requires 2.6 nm (4.8 km) of icing condition, presumably followed by clear air, while BCAR defines intermittent as alternating between maximum intermittent and maximum continuous conditions, each of 2.5 nm (4.6 km) extent. This applies up to 30,000 feet altitude (9000 m). Above 30,000 ft (9000 m), 2.5 nm (4.6 km) of maximum intermittent conditions alternate with 20 nm (36 km) of clear air.

Figure 3-1 is a plot of the BCAR LWC versus altitude maximum requirements for continuous and intermittent conditions. Note that the altitude ranges are indicated by the line lengths and that all of these standards are based on a droplet median volume diameter of 20 microns.

For turbine and turboprop engines in ice forming conditions, specific combinations of continuous and intermittent conditions and air temperatures are required.

BCAR (reference 3-11) Chapter D4-2.3.2 covers ice protection systems that are not capable of continuous operation. The maximum operating time is specified to be 30 minutes or 20 percent of the aeroplanes maximum endurance, whichever is the greater.

Visual detection by the crew of a respective section of either the mainplane or the tail-plane leading edge is required in order to check its state in respect to ice buildup (reference BCAR D4-2.1.3). In addition, an ice detector system must be installed and demonstrated unless otherwise agreed by the Board.

VI.3.3 EUROPEAN CIVIL JOINT AIRWORTHINESS REQUIREMENTS (JAR)

3.3.1 Introduction

A common set of regulations have been accepted by ten European Countries:

Belgium
Denmark
Federal Republic of Germany
Finland
France
Italy
Netherlands
Norway
Switzerland
United Kingdom

These are indicated by "J" in table 3-1.

The direction of the JARs (reference 3-13) is performed by the Airworthiness Authorities Steering Committee whose members are representatives of the Civil Airworthiness Authorities of the countries that have signed the "Arrangements Concerning the Development and Acceptance of Joint Airworthiness Requirements." A list of the countries is kept by Direction General de l'Aviation Civile (DGAC) 93, Boulevards du Montparnasse, 75270 Paris, Cedex 06, France.

Copies of the Joint Airworthiness Requirements and Amendments are available from:

Civil Aviation Authority
Printing and Publication Services
Grenville House, 37 Gratton Road
Cheltenham, Glos. GL5O 2BN
United Kingdom

Enquiries regarding the contents of the JARs should be addressed to:

The Secretary, Joint Steering Committee
c/o Civil Aviation Authority, Airworthiness Division
Brabazon House, Redhill
Surrey, RH1 ISQ
United Kingdom

The JARs were still in a formative stage as of 1986. Small airplanes are not specifically covered, nor are rotorcraft, reciprocating-engine airplanes, seaplanes, or skiplanes. The degree of conformity and commitment appears to vary among the member nations.

3.3.2 Icing Related Sections - JAR

The outline of the Joint Airworthiness Requirements (reference 3-13) and the national documents on which they are based are:

JAR-1 Definitions and Abbreviations.

JAR-22 Sailplanes and Powered Sailplanes - based on the West German LSFM (Luftuchtigkeitsforderungen fur Seg..flugzeuge and Motorsegler).

JAR-25 Large Airplanes (over 5700 kg [12,500 lbs.]) - based on the U.S. FAA FAR Part 25. (Amendments to FAR Part 25 are automatically accepted into JAR-25 unless a participating national organization calls for discussion within three months of the FAA Amendment effective date.) Sections concerned with icing flight are:

- JAR 25.929 Propeller De-Icing
- JAR 25.1093 Induction System De-Icing and Anti-Icing Provisions
- JAR 25.1416 Pneumatic De-Icer Boot System
- JAR 25.1419 Ice Protection

JAR-APU Auxiliary Power Units - Based on U.K. TSO (Technical Service Order) C77a of 20 July, 1981, and partially on U.S. FAR Part 37. Icing related sections are:

- JAR-APU Section 1-5.2 Air Intake
- JAR-APU Section 2-1.7 Ice Crystal Conditions, August 1981.

JAR-E Engines - Based on BCAR Section C, Issue 13, 28 August 1981.

JAR-P Propellers - Based on BCAR Section C, Issue 13, 28 August 1981.

JAR-TSO Joint Technical Standard Orders Authorization

JAR-AWO All Weather operations.

3.3.3 National Variants

In a limited number of cases, one or more participating countries have "National Variants" to the requirements. These are included in the JARs or in the Amendments. The amendments are printed on orange colored paper and are inserted into the JARs.

VI.3.4 OTHER COUNTRY REGULATIONS

3.4.1 Canada

Canadian airplane regulatory material is termed "Airworthiness Standards." These are the same as the U.S. Federal Aviation Administration Regulations with additional requirements based on operational conditions in Canada. The corresponding publications are:

Airplane Type	U.S. FAR	Canadian Airworthiness STD
Normal, Utility, and Arobatic Category Aeroplanes	Part 23 (reference 3-6)	Chapter 523 (reference 3-14)
Transport Category Aeroplanes	Part 25 (reference 3-7)	Chapter 525 (reference 3-15)
Normal Category Rotorcraft	Part 27 (reference 3-8)	Chapter 527 (reference 3-16)
Transport Category Rotorcraft	Part 29 (reference 3-9)	Chapter 529 (reference 3-17)

The Airworthiness Manual presents in parallel columns the U.S. FAR and the changes for the Canadian regulations. The changes are relatively few and minor. In Chapter 523 (reference 3-14), no differences from FAR 23 involve icing. In Chapter 525 (reference 3-15), the only paragraph which may have an application to some ice protection systems is:

> 525.1301-1 - Aeroplane Operations After Ground Cold Soak. Substantiation of satisfactory operation of the aeroplane as a total system, by cold weather testing or by documented evidence of satisfactory operation at low temperature, is required after the aeroplane has experienced a prolonged exposure to ground temperatures equal to or less than -35°C (-31°F) unless an alternative minimum ground temperature has been proposed by the applicant and accepted by the Minister.

For Chapters 527 (reference 3-16) and 529 (reference 3-17), the only regulations relating to icing are 527.1301-1 and 529.1301-1. These are the same as 525.1301-1 (above) except for the substitution of the word rotorcraft for the word aeroplane in the places it occurs.

3.4.2 USSR

No formal certification agreements have been made for import/export certification of aircraft between the USSR and the United States. The principle document is the work of O.K. Trunov (reference 3-18) which is often compared to the FAA's document ADS-4.

The design conditions for icing flignt listed in (reference 3-18) are as follows:

Air Temperature	LWC	MVD	Altitude
°C	0.9g/m^3	6 μm	500-9000 m(1000-30,000 ft)
-10	0.6	16	500-9000
-20	0.4	16	500-9000
-30	0.3	16	500-9000

These conditions are based on a 99% probability of occurrence. For one percent of flights in icing which exceed the LWC or MVD limits, the aircraft must be able to leave the icing condition. The responsible agency is:

USSR Ministry of Civil Aviation
Technical Science Department
37 Leningradsky Prospekt
Moscow, USSR

VI.3.5 REFERENCES

3-1 "Certification Procedures for Products and Parts," Federal Aviation Regulations, FAR Part 21, U.S.Department of Transportation, Federal AviationAdministration, Washington, D.C., 1986.

3-2 "Export Airworthiness Approval Procedures," Advisory Circular AC 21-2E, U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., May 1981 (Scheduled for revision in 1987).

3-3 "Certification and Approval of Imported Aircraft," Advisory Circular AC 21-7A, U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., November 24, 1969 (Scheduled for replacement in 1987).

3-4 "Bilateral Airworthiness Agreements," Advisory Circular AC 21-18, U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., August 20, 1982.

3-5 "Export/Import Airworthiness Certification of Civil Aeronautical Products," Document FAA-P-8110-1 U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., 1982.(This document is obtainable from the Aircraft Engineering Division (AWS-10), office ofAirworthiness, FAA, 800 Independence Ave., S.W., Washington, D.C.20591.)

3-6 "Airworthiness Standards: Normal Category Airplanes," Federal Aviation Regulations, FAR Part 23, U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., 1986.

3-7 "Airworthiness Standards: Transport Category Airplanes," Federal Aviation Regulations, FAR Part 25, U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., 1986.

3-8 "Airworthiness Standards: Normal Category Rotorcraft," Federal Aviation Regulations, FAR Part 27, U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., 1986.

3-9 "Airworthiness Standards: Transport Category Rotorcraft," Federal Aviation Regulations, FAA Part 29, U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., 1986.

3-10 "Airworthiness Standards: Aircraft Engines," Federal Aviation Regulations, FAR Part 33, U.S.Department of Transportation, Federal Aviation Administration, Washington, D.C., 1986.

3-11 "British Civil Aircraft Regulations," Civil Aviation Authority, Printingand Publishing Services, Cheltenham, Glos., England.

3-12 "British Civil Aircraft Regulations," Civil Aviation Authority, Printingand Publishing Services, Cheltenham, Glos., England, 1981 Revision.

3-13 "Joint Airworthiness Regulations," Civil Aviation Authority, Printing andPublishing Services, Cheltenham, Glos., England.

3-14 "Airworthiness Standards, Chapter 523, Normal, Utility, Aerobiotic Category Airplanes," Canadian Airworthiness Regulations, Department of Transportation, Ottowa, Ontario, Canada, K1A 0N8.

3-15 "Airworthiness Standards, Chapter 525, Transport Category Airplanes," Canadian Airworthiness Regulations, Department of Transportation, Ottowa, Ontario, Canada, K1A 0N8.

3-16 "Airworthiness Standards, Chapter 527, Normal Category Rotorcraft," Canadian Airworthiness Regulations, Department of Transportation, Ottowa, Ontario, Canada, K1A 0N8.

3-17 "Airworthiness Standards, Chapter 529, Transport Category Rotorcraft," Canadian Airworthiness Regulations, Department of Transportation, Ottowa, Ontario, Canada, K1A 0N8.

3-18 Trunov, O.K., "Icing of Aircraft and Means of Combatting It," 1965.(English language translation from the USAF Foreign Technology Division, FTD-1D(RS)T-1162-79.)

TABLE 3-1. CERTIFICATION CODES AND AGREEMENTS FOR VARIOUS NATIONS

Country	Code
Argentina	S
Australia	S B
Austria	B
Belgium	S B J
Bolivia	S
Botswana	S
Brazil	S B
Canada	S B
Czechoslovakia	B
Denmark	B J
Finland	B J
France	S B J
Germany (FRG)	S B J
Hong Kong	S
India	S
Indonesia	S
Ireland	S
Israel	S B
Italy	S B J
Japan	S B
South Korea	S
Lebanon	S
Malaysia, West	S
Morocco	S
Netherlands	S B J
Netherlands Antilles	S
New Zealand	S B
Norway	B J
Pakistan	S
Panama	S
Philippines	S
Poland	B
Portugal	S
Rhodesia	S
Romania	B

TABLE 3-1. CERTIFICATION CODES AND AGREEMENTS FOR VARIOUS NATIONS (CONTINUED)

Country	Code
Saudi Arabia	S
SingaPore	S B
South Africa	S B
Spain	B
Sweden	S B
Switzerland	S B J
Syria	S
Taiwan	S
Tunisia	S
United Kingdom	S B J
Yugoslavia	S
Zambia	S

Explanation:

J - Covered by the European Joint Airworthiness Requirements (JAR) (reference 3-12).

B - Has a Bilateral Airworthiness Agreement (BAA) with the U.S.A. as printed in FAA AC 21-18 (reference 3-4).

S - Has a Special Requirement which is printed in FAA AC 21-2E (reference 3-2).

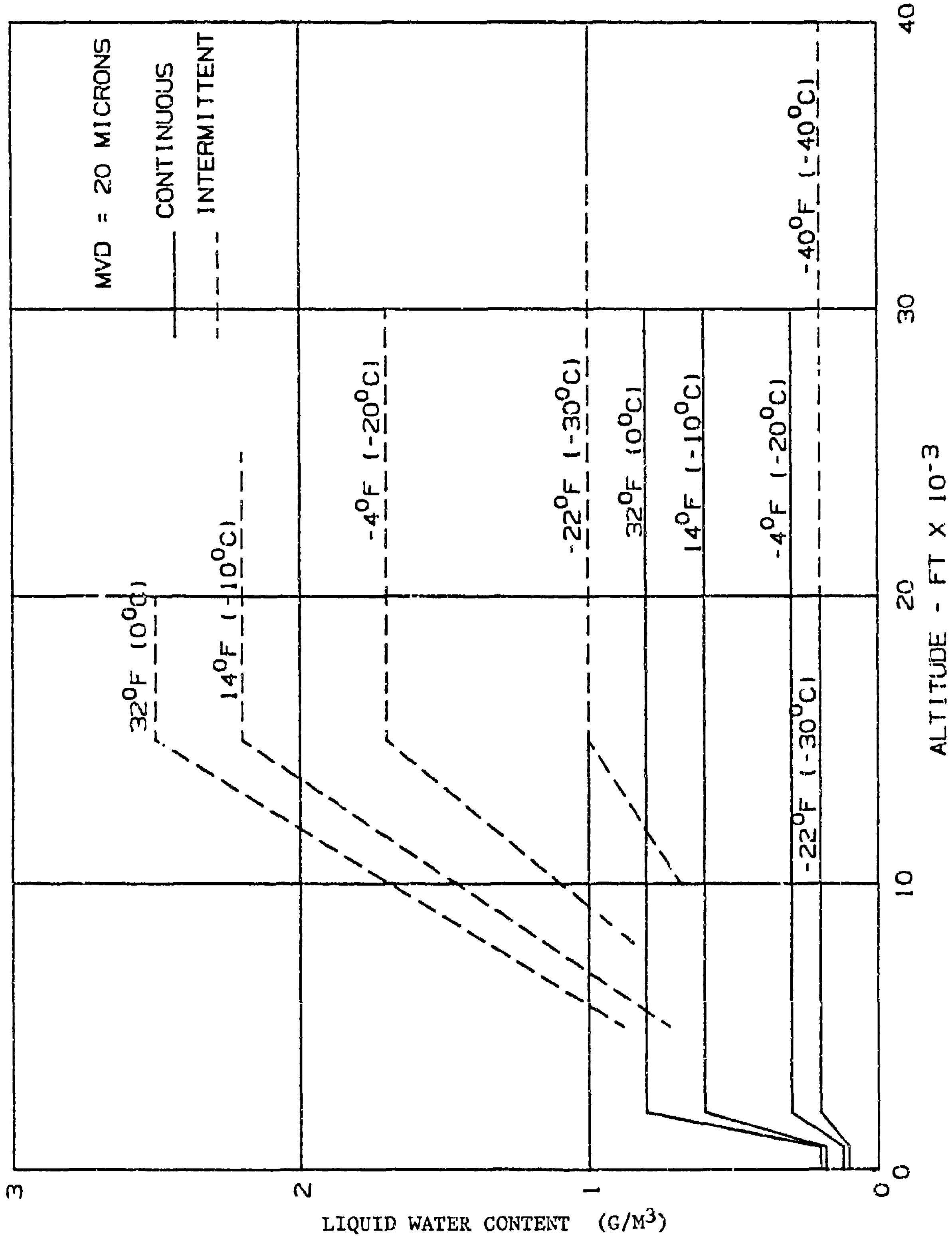

FIGURE 3-1. ICING CONDITIONS SPECIFIED BY BCAR (PRIOR TO 1981)

CHAPTER VII

ADVISORY MATERIAL

SECTION 1.0 - FAA ADVISORY CIRCULARS

CHAPTER VII
SECTION 1.0
FAA ADVISORY CIRCULARS

CHAPTER VII - ADVISORY MATERIAL

CONTENTS

SECTION 1.0 FAA ADVISORY CIRCULARS

SYMBOLS AND ABBREVIATIONS

Symbols	Description
AC	Advisory Circular
AGL	Above Ground Level
ATR	Air Transport Rating
CAR	Civil Air Regulation
DOT	Department of Transportation
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FMEA	Failure Mode and Effects Analysis
LWC	Liquid Water Content
MVD	Median Volumetric Diameter
OAT	Outside Air Temperature
SFAR	Special Federal Aviation Regulation
STC	Supplemental Type Certificate
TC	Type Certificate

GLOSSARY

light icing - The rate of accumulation that may create a hazard if flight is prolonged in this environment. Occasional use of de-icing/anti-icing equipment removes/prevents accumulation.

liquid water content (LWC) - The total mass of water contained in all the liquid cloud droplets within a unit volume of cloud. Units of LWC are usually grams of water per cubic meter of air (g/m^3).

median volumetric diameter (MVD) - The droplet diameter which divides the total water volume present in the droplet distribution in half, i.e., half the water volume will be in larger drops and half the volume in smaller drops. The value is obtained by actual drop size measurements.

moderate icing - The rate of accumulation is such that even short encounters become potentially hazardous and use of de-icing/anti-icing equipment or diversion from the area and/or altitude is necessary.

Severe icing - The rate of accumulation is such that de-icing/anti-icing fails to reduce or control the hazard requiring immediate diversion from the area and/or altitude.

VII.1.0 FAA ADVISORY CIRCULARS

VII.1.1 INTRODUCTION

The Advisory Circular System is the FAA's primary mechanism for publishing advisory information for the benefit of the aviation community and public. The objective of the system is to provide explanatory and guidance material, in nonregulatory language, which is wholly informational in nature. Its use is neither mandatory nor regulatory. An AC may not be used to add to, interpret, or relieve a duty imposed by a regulation.

The advisory circular numbering system corresponds by subject matter areas to the Subchapter, Part, and Section titles of the FAR's. When the AC is related to many FAR Parts or the relationship is general rather than specific, a FAR Subchapter (general subject area) and part number is used. For example, AC 20-73, "Aircraft Ice Protection," is the 73rd AC dealing with the FAR general subject area of "AIRCRAFT" whose part number is "20." A more specific index number is used when the AC is relevant to a specific FAR Section. For example, AC 23.1419-1, "Certification of Small Airplanes for Flight in Icing Conditions," is the first AC dealing with FAR Part 23 Section 1419 "Ice Protection."

Each FAR-related AC makes it clear that methods or procedures described for showing compliance with regulations are not the only ones acceptable to the FAA. In fact, FAR related ACs begin with a statement of purpose which contains the following disclaimer:

> "This material is neither mandatory nor regulatory in nature and does not constitute a regulation."

ACs are issued as necessary whenever the FAA determines that a need exists for additional explanation, information, guidance, or warning. They share insights and experiences which can be invaluable, especially to those pursuing aircraft certification, and can vary in length from a few pages to hundreds of pages. Periodically, the FAA issues a checklist of current ACs in a publication which is itself an AC (see Section 1.2). ACs are available from:

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

This chapter provides descriptions of those Advisory Circulars which deal most directly with icing flight certification. These descriptions are not summaries of the advisory circular information but are only intended to briefly describe the scope of the circular so that the reader can determine his need for the actual document. ACs which relate to foreign certification are described in Chapter VI, Section 3.0.

VII.1.2 AC 00-2.2: ADVISORY CIRCULAR CHECKLIST

Advisory Circular 00-2.2 (reference 1-1) gives a listing of current FAA Advisory Circulars and the status of certain other FAA publications. It is published on an annual basis in October and each year a numerical value of .1 is added to the decimal numerical designation to indicate the revision.

The full FAR outline is provided and a listing is given of cancelled ACs. The ACs are listed in both numerical and alphabetical order. A bibliography is provided with one-paragraph abstracts of other FAA publications which may be of general interest.

Instructions are given for ordering ACs, only some of which require payment. Sample copies of order and subscription forms are appended, as well as a list of Government Printing Office bookstores.

VII.1.3 AC 00-6A: AVIATION WEATHER

Advisory Circular 00-6A (reference 1-2) provides general educational material on most aspects of aviation weather. Chapter 10 addresses icing for structures as well as for engine induction and instrumentation systems. The weather patterns which are conducive to an icing environment are also discussed thus facilitating an understanding of details provided in the other chapters. Photographs and sketches are provided of ice types and various icing problems -- leading edge, inlets, propeller, pitot static port etc. (Contains 143 pages .)

VII.1.4 AC 00-45B: AVIATION WEATHER SERVICES

Advisory circular 00-45B (reference 1-3) acts as a supplement to AC 00-6A by providing details on available weather services. Details are provided on the use and interpretation of these services for the novice as well as for ATR pilots. Reports, forecasts, weather maps, and prognostic charts, many of which can be applied directly to flight planning and in flight decisions, are detailed. (Contains 123 pages.)

VII.1.5 AC 20-29B: USE OF AIRCRAFT FUEL ANTI-ICING ADDITIVES

Advisory Circular 20-29B (reference 1-4) provides details on the use of PFA-55MB and MIL-I-27686 additives as a means of FAR 25.997(b) compliance for continuous fuel flow under conditions where ice may occur in turbine aircraft fuel systems. (Contains 5 pages.)

VII.1.6 AC 20-73: AIRCRAFT ICE PROTECTION

Advisory Circular 20-73 (reference 1-5) provides information relating to the substantiation of ice protection systems on airplanes. The ice protection methods discussed are hot air, electric resistance, liquid, and expandable boot systems. Design factors for these systems are briefly presented including:

a. Sources and terminology for meteorological data with guidance for use.
b. Operational factors (cruise, climb, holding, etc.) for airplanes, helicopters, and engines, that influence the determination of the most severe design condition. Other factors considered are ice shedding, ice shapes, and the effect of ice collected on unprotected surfaces.
c. Design analysis approaches for various components of the airplane.
d. Recommended design practices.
e. Anti-ice and de-ice system considerations.

Testing methods to support or verify the analyses are outlined as follows:

a. Natural icing flight tests.
b. Dry air flight tests.
c. Flying tanker tests.
d. Self-contained spray rig tests.
e. Icing tunnel tests.
f. Ice shedding tests.
g. Combination of methods.

Test procedures for each are discussed for components such as airframe surfaces, instruments, engines, engine inlets, and helicopter rotors. Suggestions for finding icing test conditions are given and actual examples of icing encounters cited.

A summary of recommended procedures for type certification is given for airframe and engine manufacturers. An extensive bibliography, arranged by subject but limited to documents published prior to 1971, is included. (Contains 46 pages including appendices.)

VII.1.7 AC 20-93: FLUTTER DUE TO ICE OR FOREIGN SUBSTANCE ON OR IN AIRCRAFT CONTROL SURFACES

Advisory Circular 20-93 (reference 1-6) provides a warning of the hazards of flutter due to ice in, on, or around control surfaces. (Contains 2 pages.)

VII.1.8 AC 20-113: PILOT PRECAUTIONS AND PROCEDURES TO BE TAKEN IN PREVENTING AIRCRAFT RECIPROCATING ENGINE INDUCTION SYSTEM AND FUEL SYSTEM ICING PROBLEMS

Advisory Circular 20-113 (reference 1-7) provides information concerning reciprocating engine induction system icing. The impact of icing is discussed plus types or origin of ice and methods/precautions to take in the prevention of icing. (Contains 6 pages.)

VII.1.9 AC 20-117: HAZARDS FOLLOWING GROUND DE-ICING AND GROUND OPERATIONS IN CONDITIONS CONDUCIVE TO AIRCRAFT ICING

Advisory Circular 20-117 (reference 1-8) emphasizes the "clean aircraft concept" when ground conditions are conducive to icing. A great deal of information is included concerning freezing point depressant fluids. Fluid applications, including rates, expected results, and caution are addressed. (Contains 37 pages including appendices.)

VII.1.10 AC 23.1419-1: CERTIFICATION OF SMALL AIRPLANES FOR FLIGHT IN ICING CONDITIONS

Advisory Circular 23.1419-1 (reference 1-9) sets forth an acceptable means of demonstrating compliance with ice protection requirements of FAR Part 23 of the Federal Aviation Regulations (reference 1-10). This AC addresses the certification of all small airplanes having a passenger seating capacity, excluding pilots, of nine or less. This material supplements AC 20-73 (reference 1-5) which provides information on substantiation of aircraft ice protection systems.

The guidance provided in AC 23.1419-1 applies to ice protection systems approval for operating in the icing environment defined in FAR Part 25, Appendix C (reference 1-11) and may be applied to new Type Certificates (TCs), Supplemental Type Certificates (STCs), and amendments to existing TCs.

AC 23.1419-1 contains a table which specifies airplane icing certification requirements under CAR Part 3 (reference 1-12) or FAR Part 23 depending upon the date of type certification application. A summary of regulations relating to ice protection is also presented as well as related reading material and a history of icing regulations.

AC 23.1419-1 discusses the planning for certification and a listing of basic information which should be included. A detailed appendix provides a checklist of items which could affect safety in icing flight. Suggested considerations in addressing the safety concerns are also listed.

The analyses which an applicant normally prepares to substantiate his design decisions are outlined for the following:

a. Areas and components to be protected - thirteen are listed.

b. The 45 minute hold condition.

c. Flutter analysis which considers any effect of accumulated ice.

d. Power sources and power required by the ice protection system and the need to assess the effects of power failures in flight.

e. Failure analysis such as FMEA (Failure Modes and Effects Analysis).

f. Similarity analysis if certification is based on type similarity to previously certificated airplanes.

g. Impingement limit analysis including the establishment of critical conditions and limits of ice accretion.

h. Induction air system protection.

Flight test planning and performance are discussed in some detail, with each type of ice protection system considered separately. Flight tests in dry air, simulated icing, and natural icing are considered.

The effects of ice accumulations on performance and handling qualities are considered in detail. The required placarding and flight manual instructions and information are discussed with an example. (Contains 25 pages including appendicies.)

VII.1.11 AC 25.1309-1: SYSTEM DESIGN ANALYSIS

Advisory Circular 25.1309-1 (reference 1-13) provides guidance material for acceptable means of demonstrating compliance with FAR Part 25. In particular it considers probabilistic terms (as introduced in FAR Amendment 25-23) for airplane equipment systems and installations. There are no specific references made to ice protection systems. However, the principles, definitions, and clarifications given are clearly applicable to ice protection systems.

This AC addresses the need to consider the consequences of faults in separate systems which create hazards to the airplane if simultaneous failures occur. Airplane functions are divided into non-essential, essential, and critical categories. Definitions are given for 22 terms used in the regulations (examples are failure, failure analysis, failure condition, failure effect(s), failure mode, fault). Acceptable failure analysis techniques are given, including quantitative methods using (a) Fault Tree Analysis, (b) Failure Mode and Effects Analysis (FMEA), and (c) Probability Analysis. (Contains 18 pages including appendices.)

VII.1.12 AC 27-1: CERTIFICATION OF NORMAL CATEGORY ROTORCRAFT

Advisory Circular 27-1 (reference 1-14) is a large and detailed guide for certification of normal category rotorcraft. It was issued as part of an effort to achieve national standardization for rotorcraft certification. This AC covers FAA policy on methods of compliance with FAR Part 27 of Subchapter C, Chapter I, Title 14 of Code of the Federal Regulations (reference 1-15). Methods of compliance considered are in the areas of basic design, ground tests, and flight tests.

The FAA intends that additional sections will be added to this AC and sections of the outline have been reserved for such additions. Ice protection is included in two of these reserved sections which are to be added at a later date. These sections are:

Section 30.532 (FAR 27.1093) Induction System Icing Protection

Section 38.692 (FAR 27.1419) Ice Protection

(Page numbers 1 thru 1380.)

VII.1.13 AC 29-2: CERTIFICATION OF TRANSPORT CATEGORY ROTORCRAFT

Advisory Circular 29-2 (reference 1-16) consolidates FAA guidance on the certification of transport category rotorcraft. It is addressed to engineers and test pilots concerned with certification on the behalf of manufacturers, modifiers, and the FAA. It covers FAA policy on methods of compliance with FAR Part 29 (reference 1-17) for basic design, ground tests, and flight tests. The paragraphs are keyed to the FAR Part 29 numbering system. The portion which relates to flight in icing is Section 386 (FAR 29.877), Ice Protection (16 pages).

As of January 1988, no U.S. helicopter has been certified for operation in icing conditions. AC 29-2 discussions generally pertain to the full icing envelopes of FAR Part 29 Appendix C which are replicas of the FAR Part 25 Appendix C envelopes. Certifications with full ice protection systems are envisioned (rotor blades, windshields, engine inlets, stabilizer surfaces, etc.). The AC reject concept of limited certification for helicopters where the pilot has no control over the limiting variable such as is done by the U. S. Military and the British. Typically, these permit helicopter flight into known icing conditions where LWC does not exceed 1.0 g/m^3 and OAT is not colder than -4°F (-20°C). This limited certification concept was ruled out by the FAA due to the difficulty in forecasting the severity of icing conditions and the difficulty in relating the effects of fixed wing icing reports to rotorcraft.

However, AC 29-2 does offer a pilot-controllable, altitude-limited, icing design atmosphere based on the same data used to derive the Part 25 Appendix C envelopes but limited to a pressure altitude of 10,000 feet. Separate graphs are provided for continuous (stratiform) and intermittent (cumuliform) conditions. This altitude limitation reduces the severity of LWC and OAT, especially for the intermittent condition. In addition, Change 2 to AC 29-2 offers a second pilot-controllable, altitude limited, icing envelope based on more recent research data (reference 1-18), limited to 10,000 AGL. A single graph is provided that characterizes the icing atmosphere as a combination

of stratiform and low-level cumuliform conditions over icing duration distances. This altitude limitation also reduces the severity of LWC and OAT but broadens the range of MVD cloud droplet sizes to be considered. These altitude limitations can be controlled by the pilot and reflect the practical operational limits of rotorcraft and compatibility of the air traffic control system.

The only ice protection system discussed by this AC is the electrothermal de-icing type since only this system has had significant rotorcraft icing flight experience. Warnings are given regarding transferring icing flight experience from one rotorcraft type to another, or from fixed wing aircraft to helicopters. Even on similar rotorcraft types, ice accumulations and their effects can vary significantly between rotating and non-rotating components.

Suggestions are given for certification planning, analysis, and tests. Compliance demonstration methods are discussed as they apply to large rotorcraft. Instrumentation and data collection methods for this application are discussed. An extensive reference list is included. (Contains 1290 pages.)

VI.1.14 AC 91-13C: COLD WEATHER OPERATION OF AIRCRAFT

Advisory Circular 91-13c (reference 1-19) provides general information on aircraft operation in cold weather. Precautions are noted for use of anti/de-icing equipment, engine operation, and miscellaneous ground conditions. (Contains 9 pages.)

VII.1.15 AC 91-51: AIRFRAME DE-ICING AND ANTI-ICING SYSTEMS

Advisory Circular 91-51 (reference 1-20) provides information for pilots regarding ice protection system approval and results of in-flight testing. A review of accident reports in which in-flight icing was a primary factor indicated that pilots may be unaware of the following:

a. The difference between airplanes which are approved for flight into icing conditions and those which are not.

b. Certain effects of in-flight ice accumulation on airplane characteristics and performance.

Pilots are informed of the certification rules in FAR Part 23 and 25 (references 1-10 and 1-11) and are told how to determine the icing certification status. Operating rules from FAR Parts 91 and 135 (references 1-21 and 1-22) are summarized. Pilots are warned that the presence of de-icer boots on an airplane does not insure that it is certified for flight in icing conditions. Some of the physical effects of ice accumulation on an airplane are described and piloting recommendations are listed. (Contains 4 pages.)

VII.1.16 AC 123-39: HAZARDS OF WASTE WATER ICE ACCUMULATION SEPARATION FROM AIRCRAFT IN FLIGHT

This AC emphasizes the potential hazards to life and property due to lavatory fluid and potable water systems ice accumulation and resultant separation from aircraft in flight. (contains 2 pages)

VII.1.17 AC 135-9: FAR PART 135 ICING LIMITATIONS

Advisory Circular 135-9 (reference 1-23) provides information and guidance to commuter air carriers and air taxi operators concerning the requirements of Federal Aviation Regulations (FAR) Part 135, Section 135.227, Icing Conditions: Operating Limitations (reference 1-22). The information in this AC applies to certificate holders using aircraft that are not certificated for operations into icing conditions. Clarification is provided concerning paragraph 135.227, which is similar to the old paragraph 135.85. The historical background is discussed as to why some confusion has existed concerning operations in icing conditions, especially for small to medium type airplanes typical of FAR Part 23 (reference 1-10) and/or SFAR 23 certified aircraft. Operators are also referred to two other Advisory Circulars; namely, AC 00-45B (reference 1-3) and AC 91-51 (reference 1-20). (Contains 4 Pages.)

VII.1.18 REFERENCES

1-1 "Advisory Circular Checklist," U.S. Department of Transportation, Federal Aviation Administration, AC 00-2.2, (Updated annually in October).

1-2 "Aviation Weather," Department of Transportation, Federal Aviation Administration, AC 00-6A, 1975.

1-3 "Aviation Weather Services," Department of Transportation, Federal Aviation Administration, AC 00-45B.

1-4 "Use of Aircraft Fuel Anti-Icing Additives," Department of Transportation, Federal Aviation Administration, AC 20-29B, 18 January 1972.

1-5 "Aircraft Ice Protection," U.S. Department of Transportation, Federal Aviation Administration, AC 20-73, April 21, 1971.

1-6 "Flutter Due to Ice or Foreign Substance On or In Aircraft Control Surfaces," Department of Transportation, Federal Aviation Administration, AC 20-93, 29 January 1976.

1-7 "Pilot Precautions and Procedures to be Taken in Preventing Aircraft Reciprocating Engine Induction System and Fuel System Icing Problems,"Department of Transportation, Federal Aviation Administration, AC 20-113, 22 October 1981.

1-8 "Hazards Following Ground Deicing and Ground Operations in Conditions Conducive to Aircraft Icing," Department of Transportation, Federal Aviation Administration, AC 20-117, 17 December 1982, Reissued With change 1, on March 29, 1988.

1-9 "Certification of Small Airplanes for Flight in Icing Conditions," U.S. Department of Transportation, Federal Aviation Administration, AC 23.1419-1, September 2, 1986.

1-10 "Airworthiness Standards: Normal Category Airplanes," U.S.Department of Transportation, Federal Aviation Administration, Federal Aviation Regulations, FAR Part 23, Washington, D.C., 1986.

1-11 "Airworthiness Standards: Transport Category Airplanes," U.S. Department of Transportation, Federal Aviation Administration, Federal Aviation Regulations, FAR Part 25, Washington, D.C., 1986.

1-12 "Airplane Airworthiness; Normal Categories," Federal Aviation Agency, Civil Aeronautics Regulation, Part 3, Washington, D.C., May 1956.

1-13 "System Design Analysis," U.S. Department of Transportation, Federal Aviation Administration, AC 25.1309-1, September 7, 1982.

1-14 "Certification of Normal Category Rotorcraft," U.S. Department of Transportation, Federal Aviation Administration, AC 27-1, August 29, 1985.

1-15 "Airworthiness Standards: Normal Category Rotorcraft," U.S. Department of Transportation, Federal Aviation Administration, Federal Aviation Regulations, FAR Part 27, Washington, D.C., 1986.

1-16 "Certification of Transport Category Rotorcraft," U.S. Department of Transportation, Federal Aviation Administration, AC 29-2, May 28, 1985.

1-17 "Airworthiness Standards: Transport Category Rotorcraft," U.S. Department of Transportation, Federal Aviation Administration, Federal Aviation Regulations, FAR Part 29, Washington, D.C., 1986.

1-18 Masters, C.O., "A New Characterization of Supercooled Clouds Below 10,000 Feet AGL," DOT/FAA/CT-83-22, Washington, D.C., 1983.

1-19 "Cold Weather Operation of Aircraft," Department of Transportation, Federal Aviation Administration, AC 91-13c, 24 July 1979.

1-20 "Airframe De-Icing and Anti-Icing Systems," U.S. Department of Transportation, Federal Aviation Administration, AC 91-51, September 15, 1977.

1-21 "General Operating and Flight Rules," U.S. Department of Transportation, Federal Aviation Administration, Federal Aviation Regulations, FAR Part 91, Washington, D.C., 1986.

1-22 "Air Taxi Operators and Commercial Operators," U.S. Department of Transportation, Federal Aviation Administration, Federal Aviation Regulations, FAR Part 135, Washington, D.C., 1986.

1-23 "FAR Part 135 Icing Limitations," U.S. Department of Transportation, Federal Aviation Administration, AC 135-9, May 30, 1981.

CHAPTER VIII

BIBLIOGRAPHY

CHAPTER VIII

CONTENTS

CHAPTER VIII
SECTION 1.0
INTRODUCTION

CHAPTER VIII
BIBLIOGRAPHY
VIII.1.0 INTRODUCTION

This bibliography has been prepared using the bibliography created by Dr. Ken Korkan of Texas A & M University for the Society of Automotive Engineers (SAE) AC-9C Subcommittee (SAE ATR-4015) on Aircraft Icing Technology. The original bibliography has been reformatted to alphabetize by author within each subject area. Additional references have been incorporated to make the bibliography more complete concerning aircraft icing.

The principal sources for the bibliography area as follows:

(a) Bibliography of Unclassified National Research Council of Canada Aircraft Icing Reports and Publications.

(b) K. D. Korkan, "Compendium of Aircraft Anti-ice/Deice/Ice References," private communication, Texas A & M University, College Station, Texas, 1983.

(c) U. H. Von Glahn, "Selected Bibliography of NACA-NASA Aircraft Icing Publications," NASA TM 81651, 1981.

(d) Maureen Wong, Reference Department, National Research Council, Ottawa, Canada.

(e) R. J. Shaw, "Report Bibliography for the Icing Research office," private communications, NASA Lewis Research Center, Cleveland, Ohio, May 1985.

(f) "Ice Protection Investigation for Advanced Rotory Wing Aircraft," Bibliography prepared under contract DAAJ02-72-C-0054, USAAMRDL Technical Report.

(g) As provided by the members of the Aircraft Icing Technology Subcommittee.

(h) Defense Documentation Center (DDC).

(i) National Technical Information Center (NTIS).

The Icing Bibliography was originally created at Texas A & M University using an IBM Personal Computer and word processing software from Micro Pro International Corporation. Modifications and additions to the bibliography have been processed by Gates Learjet Corporation on an IBM 3081 mainframe VIII 1-1 Computer using the Statistical Analysis System (SAS). The final form of the bibliography for the Aircraft Icing Handbook has been processed using word processing software. This bibliography consists of over 2000 references which are subdivided into 23 different categories according to subject and/or title and ordered alphabetically by first author within each subject category.

CHAPTER VIII

SECTION 2.0

METEOROLOGY OF ICING CLOUDS

BIBLIOGRAPHY

VIII.2.O METEOROLOGY OF ICING CLOUDS

1. "Aerographer's Mate 1 & C," NAVEDTRA 10362-8, January 1, 1974.

2. "AN/AMQ-15 Weather Reconnaissance System," Second Quarter Tech. Prog. Rept., Bendix Aviation Corp., November 15, 1958 - February 15, 1959.

3. "Certain Aspects of Aircraft Icing in the Alaska-Aleutian Area," AAF Weather Service, Bulletin of the American Meteorological Society, December 1945.

4. "Contributions to the Theory of the Constitution of Clouds. Part Two. Observations of the Constitution of Clouds at Mount Washington," Mt. Washington Observatory Research Report, October 20, 1949.

5. "End of the Ice Age," Boeing Magazine, Vol. 24, pp. 12-13, February 1954.

6. "Forecasters' Guide on Aircraft Icing," Air Weather Service, Technical Report AWS/TR-80/001, Scott AFB, Il., March 1980.

7. "Ice Protection for Turbo-Jet Transport Airplane, Meteorological and Physics of Icing, Determination of Heat Requirements, Thermal Anti-Icing Systems for High-Speed Aircraft," SMF Fund Paper FF-1, Inst. Aero. Sciences, March 1950.

8. "Meteorological Problems Associated with Commercial Aircraft Operation," Authored by a Working Group of the NACA Subcommittee on Meteorological Problems, NACA RM 54L29, 1955.

9. "Monthly Research Bulletins. 1945-1946," Mount Washington Observatory Library.

10. "Mount Washington Daily and Monthly Summaries," Mount Washington Observatory, May 1947.

11. "Preliminary Report on the Icing Intensity Data Obtained in Flights Through Natural Icing Clouds," USAF Aeronautical Research Laboratory, WADC, Technical Report 53-48, March 1953.

12. "Routine and Cloud Data Observations, Nov. 1946 Through May 1947," Harvard - Mt. Washington Icing Research Report 1946-1947, U. S. Air Materiel Command, Tech. Report 5676.

13. "Thunderstorms (Aircraft Safety)," Controller (Germany), 20(3), pp. 40-42, September 1981.

14. "World Meteorological Organization (WMO), Technical Note, A Specialized Agency of the United Nations," MO No. 109.TP.47, 1961.

15. Abel, G. C., "Report of the First Year's Flying on the Development of Flight Testing Techniques for Finding and Measuring Natural Icing Conditions," Ministry of Supply, Aeronautical Research Council, C. P. No. 221, A.R.C. Technical Report No. A.A.E.E./Res/272, February 23, 1953.

16. Abel, G. C., "Report on 2nd Year's Flying on the Development of Flight Testing Techniques for Finding and Measuring Natural Icing Conditions," A and AEE Report Res. 278, 1954.

17. Abel, G. C., "Report on 3rd Year's Flying on the Development of Flight Testing Techniques for Finding and Measuring Natural Icing Conditions," A and AEE Report Res. 285, 1955.

18. Ambrosio, A., "Statistical Analysis of Meteorological Icing Conditions," UCLA, Los Angeles, California, December 1950.

19. Andrus, C. G., "Meteorological Notes on the Formation of Ice on Aircraft," Monthly Weather Review, June 1930.

20. Appleman, H. S., "Design of a Cloud-Phase Chart," Bull. Aner. Met. Soc., Vol. 35, No. 5, pp. 223-225, May 1954.

21. Arenberg, D. L. and Harney, P., "The Mount Washington Icing Research Program," American Meteorological Society, Bulletin 22, pp. 61-63, February 1941.

22. Arenberg, D. L., "Meteorological Factors Affecting the Icing of Aircraft," M.I.T., Master's Thesis, October 1942.

23. Arenberg, D. L., "The Triple Point of Water and the Icing of Airplanes," American Meteorological Society, Bulletin No. 19, pp. 383-384, 1938.

24. Arenberg, D. L., "Determination of Icing Conditions for Airplanes," Trans. Am. Ophys. Union, Pt. I, pp. 99-122, 1943.

25. Ashburn, E. V., "Preliminary Report on the Forecasting of Meteorological Conditions Favorable for the Formation of Ice on Aircraft," U. S. Weather Bureau, May 31, 1943.

26. Ashley, H., "Aircraft Icing Over Northwest Europe," AWS, TR 105-46, July 1945.

27. Atlas, D. and Bartnoff, S., "Cloud Visibility, Radar Reflectivity, and Drop-Size Distribution," Journal Meteorology, Vol. 10, No. 2, April 1953.

28. Atlas, D., "The Estimation of Cloud Parameters by Radar," Journal of Meteorology, Vol. II, No. 4, pp. 309-317, August 1954.

29. Austin, P. M. and Foster, H. E., "Note on Comparison of Liquid-Water Content of Air With Radar Reflectivity," Journal of Meteorology, Vol. 7, No. 2, April 1950.

30. Bannon, J. K., "Aircraft Icing at Very Low Temperatures," The Meteorological Magazine, Vol. 84, No. 997, 1955.

31. Barakan, N. B., "A Possible Cause of the Icing of Airships," Meteorologiia i Gidrologiia, No. 10-11, pp. 188-192, October-November 1939.

32. Battan, L. J., "Radar Meteorology," Univ. of Chicago Press, 1959.

33. Beard, K. V., "Terminal Velocity and Shape of Cloud and Precipitation Drops Aloft," Journal of Atmospheric Sciences, Vol. 33, 1976.

34. Beard, K. and Purppacher, H. R., "A Determination of the Terminal Velocity and Drag of Small Water Drops by Means of a Wind Tunnel," J. of the Atmospheric Sci., Vol. 26, pp. 1066-1072, 1969.

35. Beat, A C., "Occurrence of High Rates of Ice Accretion on Aircraft," Air Ministry Meteorological Office, Professional Notes, No. 106, 1952.

36. Becker, R., "A Simple Method for the Climatological Determination of the Risk of Icing," Meteorologische Rundschau, 2(5-6), pp. 175-176, May-June 1949.

37. Benum, W. F. and Cameron, H., "A Study of Ice Accretion on Aircraft over the Canadian Rockies," American Meteorological Society, Bulletin No. 25, pp. 28-33, 1944.

38. Bergrun, Norman R. and Lewis, William, "A Probability Analysis of the Meteorological Factors Conducive to Aircraft Icing in the United States," NACA TN 2738, 1952.

39. Best, A. C., "The Occurrence of High Rates of Ice Accretion on Aircraft," MRP 310, London, January 24, 1951.

40. Best, A. C., "Occurrence of High Rates of Ice Accretion on Aircraft," Meteorological Office Professional Notes, No. 106, London, 1952.

41. Bigg, E. K., "The Supercooling of Water," Proc. Phys. Soc. B., 66, No. 4, 1953.

42. Bigg, W. H., "Ice Formation in Clouds in Great Britain," Meteorological Office, Professional Notes, No. 81, 1937.

43. Blake, J. B., "Icing on the North Atlantic Routes," Regional Control Office, 8th Weather Region, Grenier Field, Manchester, N. H., August 1944.

44. Blatz, R. E. and Haines, A. W., "Icing-Intensity Data for the 1952-53 Season," WADC Technical Report No. 53-224, July 1953.

45. Booker, D. R., Davis, L. G., and Hosler, C. L., "Observations of Natural and Artificial Alteration of Cumulus Buoyancy," Proc. of International Conference on Cloud Physics, Japan, May 24-June 1, 1965.

46. Borovich, A., et al, "Cloud Physics," 1961, English Translation OTS-63-11141.

47. Boucher, R. J., "Contributions to the Theory of the Constitution of Clouds. Part One, III: A Study of the Meteorological Conditions Conducive to Icing on Mount Washington," Mt. Wash. Obs. Res. Rept., October 20, 1949.

48. Braham, Jr., R. R., and Spyers-Duran, P., "Cirrus Crystals in Clear Air," Rain Physics Res., Apr. 1965 - Apr.1966, August 1966.

49. Braham, R. R., "The aerial Observation of Snow and Rain Clouds," Proc. of the International Conference on Cloud Physics," Japan, May 24 - June 1, 1965.

50. Brock, C. W., "An Analysis of Weather Conditions Existing in Various Locations in the United States that are Conducive to Ice Formation on Aircraft," U. S. Air Materiel Command, Aero.Ice Research Lab., Engr. Rept. No. AIRL 46-56-1P, May 1947.

51. Brock, G. W., "Liquid Water Content and Droplet Size in Clouds of the Atmosphere," U. S. Air Materiel Command, Aeronautical Ice Research Lab., Engr. Report, No. IRB-46-24-1P, April 1946.

52. Brooks, C. F., "Is There an Altitude Above Which Icing Will Not Occur or Will Be Negligible?," Harvard-Mt. Washington Icing Research Report, 1946-1947, U. S. Air Materiel Command, Tech. Rept. No. 5676.

53. Browning, K. A. and Foote, G. B., "Airflow and Hail Growth in Supercell Storms and Some Implications for Hail Suppression," Q. J. R. Meteorol. Soc. (GB), 102(433), July 1976.

54. Brun, E., "A Study of Convection in Clear Air and in Wet Air," (Translation) French Committee for the Development of Aeronautical Research (G.R.A.), TN 9, 1943, North American Aviation, Inc., April 1954.

55. Burhoe, R. W. and Boardman, H. P., "List of Papers on Icing in the Atmosphere," Supplement to "List of Current Publications on Snow and Ice," by the same authors, American Geophysical Union Transactions, pp. 459-461,1942.

56. Burhoe, R. W., "Duration of Icing at Selected Intensities on Mount Washington," Harvard-Mt. Washington Icing Research Report 1946-1947, U. S. Air Materiel Command, Tech. Rept. No. 5676.

57. Burhoe, R. W., "Icing on Mount Washington and the Synoptic Weather Situation," Harvard-Mt. Washington Icing Research Report 1946-1947, U. S. Air Materiel Command, Tech. Rept. No. 5676.

58. Camp, D. W. and Frost, W., "Proceedings: First Annual Workshop on Meteorological and Environmental Inputs to Aviation Systems," NASA CP-2028/ FAA-RD-77-173, Washington, D. C., 1977.

59. Camp, D. W. and Frost, W., "Proceedings: Third Annual Workshop on Meteorological and Environmental Inputs to Aviation Systems," NASA CP-2104/ FAA-RD-77-173, Washington, D. C., 1979.

60. Camp, D. W. and Frost, W., "Proceedings: Fifth Annual Workshop on Meteorological and Environmental Inputs to Aviation Systems," NASA CP-2192/ FAA-RD-77-173, Washington, D. C., 1981.

61. Camp, D. W., et al, "Sixth Annual Workshop on Meteorological and Environmental Inputs to Aviation Systems, 26-28, October 1982, Tullahoma, TN," A84-23424, Jan. 1, 1984.

62. Carroll, T. and McAvoy, W. H., "(loc. cit.) C. G. Andrus: Meteorological Notes on the Formation of Ice on Aircraft," Monthly Weather Review, pp. 23, January 1930.

63. Clark, V., "Graphs of Maximum Liquid Water Content in Clouds," Harvard - Mt. Washington Icing Research Report 1946-1947, U. S. Air Materiel Command, Tech. Rept. 5676.

64. Clark, V., "Icing Nomenclature," Harvard - Mt. Washington Icing Research Report 1946-1947, U. S. Air Materiel Command, Tech. Rept. 5676.

65. Clark, V. F., "Liquid Water and Drop Size Measurement During June and July 1945," Mount Washington Observatory Icing Report, Vol. 1, No. 7, July 1945.

66. Conrad, V., "Statistical Investigation of the Mount Washington Series of Icing Observations," Pt. I of the Mount Washington Observatory Monthly Research Bulletin, Vol. 2, No. 10, October 1946.

67. Conrad, V., "Second Report on the Statistical Investigations of Icing," "Third Report," Harvard-Mt. Washington Icing Research Report 1946-1947, U. S. Materiel Command, Tech. Rept. No. 5676.

68. Conrad, V., "The Water Content of Clouds," (Translation) K. Academie der Wissenschaflen, Math.-Naturalis, Klasse, Denkschriften, 73, 1901, Mt. Washington Observatory Library.

69. Cornford, S. G., "A Note on Some Measurements from Aircraft of Precipitation Within Frontal Clouds," Royal Meteorological Society, Quarterly Journal, Vol. 92, pp. 105-113, January 1966.

70. Cox, M. K., "A Semi-Objective Technique for Forecasting Aircraft Icing Levels and Intensities," Unpublished Report, Det 2, 2d, Wea. Gp., May 1959.

71. Crisci, R. L., "A Plan for Improved Short-Range Aviation Weather Fore-casts," FAA-RD-78-73, June 1978.

72. Cunningham, R. and Miller, R., "Five Weather Radar Flights," M.I.T., Weather Radar Research Unit, Tech. Rept. No. 7, December 1948.

73. Das, P. K., "The Growth of Cloud Droplets by Coalescence," Indian Journal of Meteorology and Geophysics, Vol. 1, No. 2, April 1950.

74. Dolezel, E. J., Cunningham, R. E., and Katz, R. E., "Progress In Icing Research," American Meteorological Society, Bulletin 27, pp. 261-271, June 1946.

75. Dorsch, R. G.and Boyd, B., "X-Ray Diffraction Study of the Internal Structure of Supercooled Water," NACA TN 2532, 1951.

76. Dorsch, R. G. and Levine, J., "A Photographic Study of Freezing of Water Droplets Falling Freely in Air," NACA RM E51C17, 1952.

77. Dorsch, R. G. and Hacker, P. T., "A Photomicrographic Investigation of Spontaneous Freezing Temperatures of Supercooled Water Droplets," NACA TN 2142, 1950.

78. Downie, C. S., "Meteorological Research on Aircraft Icing at the Aeronautical Research Laboratory, Nov. 1947," Mount Washington Observatory Library.

79. Epperly, P. O., "Instability and Moisture Content as Factors in Ice Accretion on Aircraft in Flight and a Practical Chart for Use in Forecasting Icing Areas," U. S. Weather Bureau, Airport Station, Salt Lake City, April 1940.

80. Evanich, P. L., "NASA Lewis Research Center's Icing Research Program," Proceedings: Fifth Annual Workshop on Meteorological and Environmental Inputs to Aviation Systems," NASA CP-2192.

81. Ferguson, S. P., "Variations on the Wind Near the Ground on the Summit of Mount Washington and Apparatus for Measurement," Harvard-Mt. Washington Icing Research Report, 1976-1947, U. S. Air Materiel Command, Tech. Rept. No. 5676.

82. Findeisen, W., "Meteorological-Physical Limitations of Icing on the Atmosphere," NACA TM 885, 1939.

83. Findeisen, W., "Meteorological Commentary on D (air) 1209, Icing," Germany, Reichsamt fur Wetterdienst, Forschungs-und Erfahrungsberichte, Ser. a, No. 20, 1943.

84. Gaviola, E. and Fuentes, A. F., "Hail Formation, Vertical Currents, and Icing of Aircraft," Journal of Meteorology, No. 4, pp. 117-120, Aug. 1947.

85. Gilutin, E. A., "Statistical Analysis of Icing-Flight Observations," Journal Aero. Sci., Vol. 20, December 1953.

86. Glass, M., et al, "Water, Precipitation, Clouds and Fog: Chapter 16, 1983, Revision, Handbook of Geophysics and Space Environments," AFGL-TR- 83-0181, Air Force Geophysics Laboratory, Hanscom AFB, MA, 1983.

87. Guirand, M., "Icing," France, Office National Meteorogique, March 1939.

88. Hacker, P. T., et al, "Ice Protection for Turbojet Airplane. I-Meteorology and Physics of Icing. II-Determination of Heat Requirements. III-Thermal Anti-Icing Systems for High Speed Aircraft," Institute of Aeronautical Sciences, Special Publication No. FF-1, 1950.

89. Hacker, P. T. and Dorsch, R. G., "A Summary of Meteorological Conditions Associated with Aircraft Icing and a Proposed Method of Selecting Design Criterions for Ice Protection Equipment," NACA TN 2569, 1951.

90. Hacker, P. T., "Experimental Values of the Surface Tension of Supercooled Water," NACA TN 2510, 1951.

91. Hallanger, N. L., "A Study of Aircraft Icing," American Meteorological Society, Bulletin No. 1, pp. 377-381, 1938.

92. Hallett, John, "Characteristics of Atmosphere Ice Particles: A Survey of Technique," AFGL-TR-80-0308, Sept.1, 1980.

93. Harrison, L. P., "Discussion of the Major Factors Relating to Icing of Aircraft with a View to Securing Standardization of Procedure and Terminology," U. S. Weather Bureau, June 4, 1941.

94. Harrison, L., "Card File on References to Publications on the Problem of Icing," U. S. Weather Bureau.

95. Heath, E. D. and Cantrell, L.M., "Aircraft Icing Climatology for the Northern Hemisphere," Air Weather Service Technical Report 220, June 1972.

96. Horne, T. A., "The Icing Options: Avoid Ice If You Can, Deal With It If You Must," AOPA Pilot, February 1981, pp. 52-63.

97. Horne, T. A., "Understanding Ice," AOPA Pilot, February 1981, pp. 80-86.

98. Horne, T. A., "Reflections on a Black Art: The Unknown Icing Certification," AOPA Pilot, September 1981, pp. 43-48.

99. Howell, W., "The Growth of Cloud Drops in Uniformly Cooled Air," Journal of Meteorology, Vol. 6, pp. 134-149, April 1949.

100. Huschke, R. E., et al, "Glossary of Meteorology," Third Printing, American Meteorological Society, Boston, MA, 1980.

101. Ingebo, R. D,, "Formulation and Characterization of Simulated Small-Droplet Icing Clouds," AIAA-86-0409, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

102. Jackson, G. C., "Icing Climatology for Northern Europe," AFFDL-TM-79-83-WE, August 1979.

103. Jackson, G. C., "Icing Climatology for Northern Europe," AFWAL-TM-80-16-FSW, February 1980.

104. Jacobs, W. C., "Forecasting the Formation of Hoar Frost on Wing Surfaces of Aircraft Parked in the Open," Hq. AAF, Weather Division, Rept. No. 897, 1944.

105. Jailer, R. W., "Evaluation of Northern Hemisphere Icing Probabilities," WADC TN 55-225.

106. Jaumotte, J., "An Extraordinary Case of Supersaturation in the Free Air," Ciel et Terre, XLI, No. 3, pp. 42-49, March 1925. (Abstracted in Monthly Weather Review, February 1925).

107. Jeck, R. K., "A New Data Base of Supercooled Cloud Variables for Altitudes up to 10,000 Feet AGL and the Implications for Low Altitude Aircraft Icing," DOT/FAA/CT-83-21, NRL Report 8738, Washington, D.C., 1983.

108. Jelinek, A., "Climatological Conditions for Flying Along Norwegian Air Routes," Germany, Reichsamt fur Wetterdienst, Forschungs-und Erfahrungberichte, Ser. A., No. 2, 1940.

109. Jones, A. R. and Lewis, W., "Recommended Values of Meteorological Factors to be Considered in the Design of Aircraft Ice-Prevention Equipment," NACA TN 1855, March 1949.

110. Jones, R. F., "Meteorology and Supersonic Flight," Nature, Vol. 212, pp. 1181-1185, December 10, 1966.

111. Katz, L. G., "Climatological Probability of Aircraft Icing," AWS-TR-194, January 1967.

112. Kline, C. B. and Walker, J. A., "Meteorological Analysis of Icing Conditions Encountered in Low Altitude Stratiform Clouds," NACA TN 2306, 1951.

113. Kline, D. B., "Investigation of Meteorological Conditions Associated with Aircraft Icing in Layer-Type Clouds for 1947-48 Winter," NACA TN 1793, 1949.

114. Kohler, H., "On Water in the Clouds," Geofysike Publikasjoner, 5, No. 1, 1928.

115. Kozharin, V., "Evaluation Aircraft Icing Conditions in Stratus and Stratocumulus Clouds," (Translation) Civil Aviation, No. 11, 1957.

116. Kramer, H. P. and Rigby, M., "Selective Annotated Bibliography on Cloud Physics and Rain Making," Meteorological Abstracts and Bibliography, 1(3), pp. 174-190, March 1950.

117. Lacey, J. K., "A Study of Meteorological and Physical Factors Affecting the Formation of Ice on Airplanes," American Meteorological Society, Bulletin, No. 21, pp. 357-367. November 1940.

118. Langmuir, I., "Super-Cooled Water Droplets in Rising Currents of Cold Saturated Air," Precipitation Static Studies, Oct. 1943 to August 1944.

119. Leven, L. M., "Distribution Function of Cloud and Rain Drops by Size," DAN USSR, Vol. 94, Nov. 6, 1954.

120. Lewis, W., "Icing Properties of Non-Cyclonic Winter Stratus Clouds," NACATN 1391, 1947.

121. Lewis, W., "Icing Zones in a Warm Front System Mth General Precipitation," NACA TN 1392, 1947.

122. Lewis, W., "A Flight Investigation of the Meteorological Conditions Conducive to the Formation of Ice on Airplanes," NACA TN 1393, 1947.

123. Lewis, W., Kline D. B., and Steinmetz, C. P., "A Further Investigation of the Meteorological Conditions Conducive to Aircraft Icing," NACA TN 1424, 1947.

124. Lewis, W. and Hoecker, Jr., W. H., "Observations of Icing Conditions in Flight During 1948," NACA TN 1904, June 1949.

125. Lewis, W. and Bergrun, N. R., "A Probability Analysis of the Meteorological Factors Conducive to Aircraft Icing in the United States," NACA TN 2738, 1952.

126. Lewis, W., "Revised Estimate of Maximum Water Concentration in Heavy Rain," NACA Committee on Operating Problems, May 1954.

127. Masters, C. O., "A New Characterization of Supercooled Clouds Below 10,000 Feet AGL," DOT/FAA/CT-83-22, Washington, D.C., 1983.

128. McGready, Jr., P. B., Takeuchi, D. M., and Todd, C. J., "Droplet Distribution and Precipitation Mechanisms in a Particular Convective Cloud System," Proc. of the International Conference on Cloud Physics, Japan, 1965.

129. Minser, E. J., "Studies of Synoptic Free-Air Conditions for Icing of Aircraft," American Meteorological Society, Bulletin No. 19, pp. 111-122, 1938.

130. Minser, E. J., "Icing of Aircraft," American Meteorological Society, Bulletin No. 16, pp. 129-133, May 1935, Transcontinental and Western Air, Inc., Mieteorological Dept. Tech. Note, No. 1, Rev., November 7, 1942.

131. Mironovitch, V. and Viaut, A., "The Risk of Icing as a Function of Weather Type," La Meteorologie, No.11, pp. 498-503, 1935.

132. Perkins, P. J., "Preliminary Survey of Icing Conditions Measured During Routine Transcontinental Airline Operation," NACA RM E52J06, 1952.

133. Perkins, P. J., "Statistical Survey of Icing Data Measured in Scheduled Airline Flights over the United States and Canada from November 1951 to June 1952," NACA RM E55F28a, 1955.

134. Perkins, P. J., Lewis, W., and Mulholland, D. R., "Statistical Study of Aircraft Icing Probabilities at the 700 and 500 Millibar Levels Over Ocean Area in the Northern Hemisphere," NACA TN 3984, 1957.

135. Perkins, P. J., "Icing Frequencies Experienced During Climb and Descent by Fighter-interceptor Aircraft," NACA TN 4314, July 1958.

136. Perkins, P. J., "Summary of Statistical Icing Cloud Data Measured Over United States and North Atlantic, Pacific, and Arctic Oceans During Routine Aircraft Operations," NASA Memo 1-19-59E, 1959.

137. Pruppacher, N. R. and Klett, J. D., "Microphysics of Clouds and Precipitation," Dordrecht, The Netherlands, D. Reidel Publishing Co., 1970.

138. Reinbold, 0., "Contributions to Aircraft Icing Problems," Meteorologische Zeitschrift, No. 52, pp. 49-54, February 1935.

VIII.2.0 METEOROLOGY OF ICING CLOUDS (CONTINUED)

139. Ryder, P., "The Role of Meteorology in Helicopter Icing Problems," Meteorological Magazine, 1978, Vol. 107, pp. 140-147.

140. Sand, W. R., et al, "Icing Conditions Encountered by a Research Aircraft," Journal of Climate and Applied Meteorology, Vol. 23, No. 10, Jan. 1, 1984.

141. Shaw, R. J., "The NASA Aircraft Icing Research Program. Proceedings: Sixth Annual Workshop on Meteorological and Environmental Inputs to Aviation Systems," NASA CP-2274, 1982.

142. Smith, R. B., "Icing at Mount Washington Near the Tops of Clouds Layers," Harvard-Mt. Washington Icing Research Report 1946-1947, U. S. Air Materiel Command, Tech. Rept. No. 5676.

143. Squires, P., "The Growth of Cloud Drops by Condensation. I - General Characteristics," Journal Sci. Res., Series A, Physical Sci., Vol. 5, No. 1, March 1952.

144. Taylor, B. F., "A Supplementary Report to "A Case Study of Icing in the Alaskan-Aleutian Area," U. S. Air Forces, Weather Central, 11th Weather Region, February 12, 1946.

145. Tucker III, W. B., "Current Procedures for Forecasting Aviation Icing: A Review," CRREL, Special Report 83-24, August 1983.

146. Uchida, E., "On the Characteristics of Large Droplets in the Cloud-Droplet Population," Proc. of the International Conference on Cloud Physics, Japan, May 24-June 1, 1965.

147. Viaut, A., "Meteorology of (Aerial) Navigation," Paris, Editions Blondella Rougery, 1949.

148. Vorontsov, P. A., "Aerological Conditions of Ice Formation on Aircraft," Akademiia Nauk, USSR, Izvestiia, Ser. Geogr. i Geofiz, No. 3, pp. 334-362, 1940, Sumary in German.

149. Whipple, P. C., "Icing in Relation to Air Masses and Fronts, November 1946.

150. Zaitsev, V. A., "liquid Water Content and Distribution of Drops in Cumulus Clouds," National Research Council of Canada, Technical Translation TT-395, Ottawa, 1953.

151. Zamorski, A. D., "Meteorological Conditions for Ice Formation," (Translation) NAVAER 50-IR-106, Translated January 5, 1944.

152. Zavarina, M. B., "Aeroclimatic Factors in Aircraft Icing," (Translation) Leningrad, Gidrometeoizdat, 1951.

CHAPTER VIII

SECTION 3.0

METEOROLOGICAL INSTRUMENTS

BIBLIOGRAPHY

VIII.3.O METEOROLOGICAL INSTRUMENTS

1. "Aircraft Pressure-Type Icing Rate Meter for Statistical Studies of Icing Conditions," NASA Lewis Flight Propulsion Laboratory, Icing Research Branch.

2. "An Investigation of Principles and Instruments for the Measurement of Icing Intensity," Technical Report No. 53-225, Wright Air Development Center, August 1953.

3. "Cloud Particle Measurement Symposium - Summaries and Abstracts," U.S. National Center for Atmospheric Research, Boulder, Colorado, September 1982.

4. "Detector, Ice, Air Intake Duct Aircraft Engines and Airframe System,"MIL-D-8181B, March 1, 1965.

5. "Evaluation of Icing Rate Systems on the SH-3D Helicopter," AD-855-268L.

6. "Instruction Manual Johnson-Williams LWC Liquid-Water-Content Indicator,Model LWH," Document 61WC0-0621, Johnson Williams, Inc.

7. "Meter Measures Icing Rate," Air Force, 32(2):39, February 1949.

8. "Monthly Research Bulletins," Mount Washington Observatory, Vol. 1, Monthly Icing Report Series, Vol. 2, The Multi-Cylinder Method, 1945- 1946.

9. "MRI Instrumented Aircraft, Appendix A, Learjet Model 36 Weather Aircraft,"Meteorology Research Inc., Altadena, California, 1980.

10. "Product Data, PMS DS-FSSP," Particle Measuring System, Inc., Boulder, Colorado, July 1980, Meteorology Research Inc., Altadena, California, 1980.

11. "Reduction of Rotating Cylinder Data; Instructions for Calculating the Liquid Water Content. Effective Drop Size and Effective Drop Distributions from Rotating Cylinder Data Obtained from Average Speed Aircraft," M.I.T., Deicing Lab., October 1945.

12. "Review of Icing Detection for Helicopters," NRC Aero Report LR-334,March 1962.

13. "Rosemount Ice Rate System for Helicopters," Product Da a Sheet 2517,Rosemount, Inc., 1984.

14. "Selection of an Ice Detector for Jet and Turboprop Aircraft," Rosemount Engineering Report No. 1688P.

15. "Specification 951469A - Mk 12B Ice Detector Unit IDU-3B," Leigh Instrument Limited, Ontario, Canada, September 1983.

16. "The Multi-Cylinder Method," Mt. Washington Observatory Monthly Research Bulletin, Vol. II, No. 6, June 1946.

17. "Translation of Russian Research Helicopter-Borne Radiometeorograph,"AD-637-466.

18. "Weather Surveillance Radar Manual," United States Weather Bureau,February 1, 1960.

19. "961469A- Specification MK 12b Ice Detection Unit IDU-3B," Leigh Part Number 127389-3, Leigh Instruments Limited, September 1983.

20. Bain, M. et al, "Aircraft Measurements of Icing in Super cooled and Water Droplet/Ice Crystal Clouds," American Meteorological Society, December 4, 1981.

21. Barlow, G. F., "Helicopter Flight Trials of "Knollenberg" Cloud Particle Sizing Instruments," RAE Technical Report 81054, 1981.

22. Barner, "Ice Formation Measuring Equipment Type C-16O," (Translation)U.S. Air Force Translation, No. 611, September 1946.

23. Baumgardner, D. and Dye, J. E., "The 1982 Cloud Particle Measurement Symposium," Bulletin of the American Meteorological Society, Vol. 64, April 1983.

24. Baumgardner, D., "An Analysis and Comparison of Five Water Droplet Measuring Instruments," Journal of applied Meteorology, Vol. 22, No. 5, May 1983.

25. Baumgardner, D. and Dye, J. E., "Evaluation of the Forward Scattering Spectrometer Probe. Part I: Electronic and Optical Studies," Journal of Atmospheric and Oceanic Technology, Vol. 1, No. 4, December 1984.

26. Baumgardner, D., Strapp, W., and Dye, J. E., "Evaluation of the Forward Scattering Spectrometer Probe. Part II: Corrections for Coincidence and Dead-Time Losses," Journal of Atmospheric and Oceanic Technology, Vol. 2, No. 4, December 1985.

27. Baxter, D. C., "Some Thermal Aspects of the Design of Heated Probes for Measuring Cloud Water Content," NRC Report LR-72A, August 1958.

28. Baxter, D. C., "A Review of Radiation Scattering Methods for Measuring Cloud Droplet Size," NRC Report MD-4O, April 1954.

29. Belz, R. A. and Menzel, R. W., "Particle Field Holography at Arnold Engineering Development Center," Optical Engineering, Bul. 18, No. 3, May-June 1979, pp. 256-265.

30. Bentley, H. T., "Fiber Optics Particle-Sizing System," AEDC-TR-73-111(AD-766-647), September 1973.

31. Bigg, F. J. and Abel, G. C., "Note on Sampling and Photographing Cloud Droplets in Flight," RAE TN ME 156, 1953.

32. Bigg, F. J., "Development and Test of a Cooled Rotating Disc Icing Meter," RAE TN ME 200, 1955.

33. Bigg, F. J., Day, D. J., and McNaughton, I. I., "The Measurement of Ice Crystal Clouds," Aircraft Ice Protection Conference, 1959.

34. Bottger, R., "Suitability of Disc and Cone for Ice Layer Measuring by Aerodynamic Drag," (Translation) U. S. Air Force Translation Report No. F-TS-767-RE, August 1946.

35. Brown, E. N. "An Evaluation of the Rosemount Ice Detector for Aircraft Hazard Warning and for Undercooled Cloud Water Content Measurements," NCAR/TN-183, October 1981.

36. Brun, R. J. and Kleinknecht, K. S., "An Instrument Employing Coronal Discharge for Determination of Droplet Size Distribution of Clouds," NACA TN 2458, 1951.

37. Brun, E., "Icing Detectors," (Translation) Project No. M992-4, Universityof Michigan - Engineering Research Institute, March 1953. .

38. Brun, R. J. and Mergler, H. W., "Impingement of Water Droplets on a Cylinder in an Incompressible Flow Field and Evaluation of Rotating Multi-Cylinder Method for Measurement of Droplet-Size Distribution, Volume Median Droplet size, and Liquid Water Content in Clouds," NACA TN 2904, 1953.

39. Brun, R. J. and Vogt, D., "Impingement of Cloud Droplets on 36.5- Percent-Thick Joukowski Airfoil at Zero Angle of Attack and Discussion of Use as Cloud Measuring Instrument in Dye Tracer Technique," NACA TN 4035, 1957.

40. Brun, R. J., Lewis, W., Perkins, P. J., and Serafini, J. S., "Impingement of Cloud Droplets on a Cylinder and Procedures for Measuring Liquid-Water-Content and Droplet Sizes in Supercooled Clouds by Rotating Multi-Cylinder Method," NACA Rep. 1215, 1955. (Supersedes NACA TN's 2903, 2904, and NACA RM E53D23.)

41. Cannon, T. W., "Imaging Devices," Atmospheric Technology, No. 8, pp. 32-37, Spring 1976.

42. Cerni, R.A. and Cooper, W. A., "Sizing of Cloud Droplets with an FSSP," Cloud Particle Measurement Symposium: Summaries and Abstracts, D. Baumgardner and J.E. Dye, eds., NCAR/TN-199+PROC, National Center for Atmospheric Research, 1982, pp. 20-26.

43. Cerni, T. A., "Determination of the Size and Concentration of Cloud Drops with an FSSP," Journal of Climate and Applied Meteorology, Vol. 22, August 1983.

44. Clark, V. F., "Liquid Water and Drop Size Measurement During June and July 1945," Mount Washington Observatory Icing Report, Vol. 1, No. 7, July 1945.

45. Clark, V. F., "Conditions for Run-Off and Blow-Off of Catch on Multi- Cylinder Icing Meter," Harvard-Mount Washington Icing Research Report 1946-1947, U. S. Air Materiel Command, Tech. Rept. 5676.

46. Conrad, V., "Statistical Investigation of the Mount Washington Series of Icing Observations," Pt. 1 of the Mount Washington Observatory Monthly Research Bulletin, Vol. 2, No. 10, October 1946.

47. Cornford, S. G., "A Note on Some Measurements from Aircraft of Precipitation Within Frontal Clouds," Royal Meteorological Society, Quarterly Journal, Vol. 92, pp. 105-113, January 1966.

48. Crowley, J. E., and Konar, A. F., "Alpha Radiation Hygrometer. Volume II - Frost-Point Hygrometer for W-47 Aircraft," Final Report, 8 June 1962 - 15 July 1964, AFCRL-64-69O, AD-608-496.

49. Davison, I., Krollman, C. and Malin, W., "Development of a Deiced, Fast Response, Dual Element Total Temperature Sensor," Technical Report, Feb. 1961 - Nov. 1963, REC-5644A, SEWAGE-To-65-36, AD-6[illegible]2-247.

50. Day, C. J., "A Refrigerated Disc Icing Meter," British Meteorology Office, M.R.P. 916, 1955.

51. Deom, A. A. and Garnier, J. C., "Detection and Measurement of Ice Accretion on a Profile by an Ultrasonic Method," AIAA-87-O179, AIAA 25th Aero-space Sciences Meeting, January 12-15, 1987, Reno, Nevada.

52. Downie, C. S., "The Rotating Cylinder Method for Obtaining Icing Intensity Data," U. S. Air Materiel Command, Aeronautical Ice Research Laboratory, Report No. AIRL 48-3-2P, September 1947.

53. Downie, C. S., "Calculation of Rotating Cylinder Data," AIRL Report, IRB, 46-30-1F, March 1946.

54. Dye, J. E. and Baumgardner, D., "Evaluation of the Forward Scattering Spectrometer Probe Part I: Electronic and Optical Studies," Journal of Atmospheric and Oceanic Technology, Volume 11, December 1984, pp. 329-344.

55. Elliot, H. W., "Improved Droplet Camera," Natl. Res. Council, Canada,Lab. Note A1-3-50, November 1950.

56. Falconer, R. E. and Schaefer, V. J., "A New Plane Model Cloud Meter," General Electric Research Lab,, Occasional Report No. 2, Project Cirrus, May 1948.

57. Farmer, W. M., "Measurement of Particle Size, Number, Density and Velocity using a Laser Interferometer," Applied Optics, Vol. 11, No. 11, November 1972, pp. 2603-2616.

58. Findeisen, W., "The Thermometric Ice Warning Indicator," (Translation) Project No. M992-B, University of Michigan Engineering Research Institute, August 1952.

59. Fitzgerald, D. R. and Byers, H. R., "Aircraft Electrostatic Measurement Instrumentation and Observations of Cloud Electrification. Final Report," AFCRL-TR-62-805, February 28, 1962.

60. Forester, G. O. and Lloyd, K. F., "Methods of Ice Detection and Protection on Modern Aircraft," World Aerospace Systems, Vol. 1, pp. 86-88, February 1965, Journal of the Society of Licensed Aircraft Engineers and Technologists, Vol. 3, pp. 20-22, July 1965.

61. Forester, G. O. and Orzechowski, J. S., "Icing and Its Measurement," Environmental Effects on Aircraft and Propulsion Systems, Naval Air Propulsion Test Center, Proc. of the 9th Annual National Conference, October 7-9, 1969.

62. Foster, H., "The Use of Radar in Weather Forecasting with Particular Reference to Radar Set AN/CPS-9," M.I.T. Dept. of Meteorology, TR 20, AD-5459, AIR Weather Service, TR 105-97, November 1952.

63. Fraser, D. and Baxter, D. C., "Reference Pressure Probes for an Orifice-Type Icing Detector," NRC Report LR-129, April 6, 1955.

64. Fraser, D., "Orifice-Type Ice Detector - Preliminary Icing Tunnel Tests of Functioning as Ice Detector, Rate-of-Icing Meter, and Icing-Severity Meter," NRC Report LR-3, July 1951.

65. Fraser, D., "The Characteristics of an Orifice-Type Icing Detector Probe," NRC Report LR-71, June 9, 1953.

66. Fraser, D., "Comparative Tests of two Icing Detectors," NRC Test Report TR-32, June 1952.

67. Fraser, D., Rush, C. K., and Baxter, D. C., "Thermodynamic Limitations of Ice Accretion Instruments," NRC Report LR-32, August 22, 1952.

68. Friswold, F. A., Lewis, R. D., and Wheeler, Jr., R. C., "An Improved Continuous-Indicating Dew-Point Meter," NACA TN-1215.

69. Gelder, T. F., Snyers, W. H., and Von Glahn, U. H., "A Dye-Tracer Technique for Experimentally Obtaining Impingement Characteristics of Arbitrary Bodies and a Method for Determining Droplet Size Distribution," NACA TN 3338, 1955.

70. Gilruth, R. R., Zalovcik, J. A., and Jones, A. R., "Flight Investigation of a NACA Ice-Detector Suitable for use as a Rate-of-Icing Indicator," NACA Wartime Report L364, November 1942.

71. Ginnings, D. C. and Corriccini, R. J., "An Improved Ice Calorimeter - The Determination of its Calibration Factor and the Density of Ice at 0 Degrees C," Journal Research, National Bureau of Standards, No. 38, pp. 583-591, June 1947.

72. Glass, M. and Grantham, D. D., "Response of Cloud Microphysical Instruments to Aircraft Icing Conditions," AFGL-TR-81-1092, AFGL-ERP-747, July 6, 1981.

73. Glass, M., "Droplet Spectra and Liquid Water Content Measurements In Aircraft Icing Environments," AFGL-TR-82-0344, AD-A122-516/6, Nov. 18, 1982.

74. Golitzine, N., "Method of Measuring the Size of Water Droplets in Clouds,Fogs, and Sprays," NRC Report ME-177, March 1950.

75. Goss, J. K., "Rotating Disc Icing Meter - IRB Model 2," U. S. Air Materiel Command, Aeronautical Ice Research Lab., Engr. Rept., No. IRB-46-39-4P,July 1946.

76. Hacker, P. T., "An Oil-Stream Photomicrographic Aeroscope for Obtaining Cloud Liquid Water Content and Droplet Size Distribution in Flight," NACA TN 3593, 1956.

77. Hansman, R. J. and Kirby, M. S., "In-Flight Measurement of Ice Growth on an Airfoil Using an Array of Ultrasonic Transducers," AIAA-87-0187, AIAA 25th Aerospace Sciences Meeting, January 12-15, 1987, Reno, Nevada.

78. Hansman, R. J. and Kirby, M. S., "Real-Time Measurement of Ice Growth During Simulated and Natural Icing Conditions Using Ultrasonic Pulse-Echo Techniques," AIAA-86-0410, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

79. Hansman, R. J. and Kirby, M. S., "Measurement of Ice Accretion Using Ultrasonic Pulse-Echo Techniques," AIAA Paper 85-0471, 1985, Journal of Aircraft, Vol. 22, No. 6, June 1985.

80. Hardy, J. K., "Note on Ice Detectors," RAE Tech. Memo, ME 23, 1946.

81. Hendrick, Jr., R. W., "A Forward-Scattering Optical Disdrometer," A/CNo. 70-171.

82. Hess, C. F. and Spectron, F. L., "Optical Techniques to Characterize Heavy Rain," AIAA-86-0292, Development Labs., Inc., Costa Mesa, Ca, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986, Reno, Nevada.

83. Hobbs, P. B., Farber, R. J., and Joppa, R. G., "Collection of Ice Particles from Aircraft Using Decelerators," J. Appl. Meteorol., 12(3), April 1973.

84. Hovenac, E. A., Hirleman, E. D,, and Ide, R. F., "Calibration and Sample Volume Characterization of PMS Optical Array Probes," Presented at the International Conference on Liquid Atomization and Spray Systems (ICLASS 85)," London, England, July 1985.

85. Hovenac, Edward A., "Calibration of Droplet Sizing and Liquid Water Content Instruments: Survey and Analysis," NASA CR-175099, May 1986.

86. Howe, J. B., "An Evaluation of Two Cook Ice Detector Probes as Instruments for Measuring the Constitution of Icing Clouds," Technical Note No. 557, Aeronautical Research Laboratories, June 1956.

87. Howe, J. R., "The Rotating Multi-Cylinder Method for Use in Icing Wind Tunnels - Preliminary Report," Technical Note No. 552, Wright Air Development Center, Project No. R560-74-6.

88. Howell, W. E., "Comparison of the Three Multi-Cylinder Icing Meters and Critique of Multi-Cylinder Method," NACA TN 2708, 1952.

89. Howell, W. E., "Instructions for Making Icing Observations by the Multi-Cylinder Method," Mount Washington Observatory, Monthly Research Bulletin 2, No. 12, December 1946.

90. Howell, W. E., "Report on the Harvard Mount Washington Icing Meter," Harvard-Mt. Washington Icing Research Report 1946-1947, U. S. Air Materiel Command, Tech. Rept. 5676.

91. Howell, W. E., "Contribution to the Evaluation of the Multi-Cylinder Icing Meter," Harvard-Mt. Washington Icing Research Report 1946-1947, U. S. Air Materiel Command, Tech. Rept. 5676.

92. Howell, W. E., "Effect of the Vertical Gradients of Wind Speed and Water Content on Measurements with the Multi-Cylinder Icing Meter," Harvard- Mt. Washington Icing Research Report 1946-1947, U. S. Materiel Command, Tech. Rept. 5676.

93. Howell, W. E., "Comparative Measurements of Cloud Drop Sizes and Size Distribution by Multi-Cylinder and Impact Methods," Harvard-Mt. Washington Icing Research Report 1946-1947, U. S. Air Materiel Command, Tech. Rept. 5676.

94. Howell, W. E., "Experiments with a Ranging Chamber for Measuring Drop Size Distribution," Harvard-Mt. Washington Icing Research Report 1946- 1947, U. S. Air Materiel Command, Tech. Rept. 5676.

95. Howell, W. E., "A Comparison of Three Multi-cylinder Icing Meters and a Critique of the Multi-Cylinder Method," Mount Washington Observatory Report, Final Rept. July 15, 1949.

96. Howlett, D. P., "Ice Detectors," Aircraft Ice Protection Conference, 961.

97. Hull, W. L. and Schmidt, L. D., "AiResearch Ice Detection System for Aircraft Application," AE-75 27-R, May 1960.

98. Hunt, J. D., et al, "Subsystem Testing and Flight Test Instrumentation,"AGARD-CP-299, April 1, 1981.

99. Hunt, J. D., et al, "A Comparison of Particle Diagnostic Systems," AEDC-TR-80-33, Aug. 1, 1981.

100. Hunt, J. D., et al, "Engine Icing Measurement Capabilities at the AEDC,"AEDC TN 37389.

101. Ide, R. F. and Richter, G. P., "Evaluation of Icing Cloud Instruments for 1982-83 Icing Season Flight Program," AIAA Paper 84-0020, TM-83569, USAAVSCOM 84-C-1, 1984.

102. Ide, R. F., et al, "Comparison of Icing Cloud Instruments for 1982-1983 Icing Season Flight Program," NASA TM-83569, N84-29870, Jan. 1, 1984.

103. Idrac, J., "Ice Warning Devices," (Translation) S.E.M.L., 1945, University of Michigan, Engr. Res. Inst., TR 31, July 1953.

104. Ives, R. L., "Detection of Supercooled Fog Droplets," Journal Aero. Sci.,January 1941.

105. Jensen, D., "Icing Rate Indicator System," REC 269198, Jan. 1, 1969.

106. Jones, A. R. and Lewis, W., "A Review of Instruments Developed for the Measurement of the Meteorological Factors Conducive to Aircraft Icing," NACA RM A9C09, 1949.

107. Jones, R. F., "Aircraft Observations of Radar Reflecting Particles Above the Freezing Level," MRP 683, Great Britain, November 16, 1951.

108. Katz, R. E. and Cunningham, R. M., "Aircraft Icing Instruments; Instruments for Measuring Atmospheric Factors Related to Ice Formation on Airplanes II," M.I.T. Dept. of Meteorology, De-Icing Research Lab., March 1948.

109. Kebabian, P. L., "Fabrication and Testing of an Airborne Ice Particle Counter," NASA CR-152420, October 1976.

110. King, W. D., Parkin, D. A., and Handsworth, R. J., "A Hot Wire Liquid Water Device Having Fully Calculable Response Characteristics," Journal of Applied Meteorology, Vol. 17, December 1978.

111. King, W. D., et al, "Icing Wind Tunnel Tests on the CSIRO Liquid Water Probe," Journal of Atmospheric and Oceanic Technology, Volume 2, September 1985, pp. 340-352.

112. Knollenberg, R. G., "Comparative Liquid Water Content Measurements of Conventional Instruments with an Optical Array Spectrometer," Journal of Applied Meteorology, Vol. 2, April 1982.

113. Knollenberg, R. G., "The Optical Array: An Alternative to Scattering or Extinction for Airborne Particle Size Determination," Journal of Applied Meteorology, Vol. 9, No. 1, February 1970.

114. Kowles, J., "A Discussion of Icing Rate Measurement and the Rosemount Icing Rate System," Rosemount 67312A, Jan. 1, 1973.

115. Lange, K. O., "The Application of the Harvard Radio Meteorograph to a Study of Icing Conditions," Journal of the Aeronautical Sciences, No. 6, pp. 59-63, 1938.

116. Langmuir, I., "Aerological Instruments for the Study of Icing and Precipitation Static Problems," General Electric Research Lab., October 1944.

117. Lazelle, B. D., "Tunnel Testing of the NAE Ice Detector Type T.26O," D. Napier and Sons, Report DEV/TR/137/912, 1954.

118. Levine, J. and Kleinknecht, K. S., "Adaptation of a Cascade Impactor to Flight Measurement of Droplet Size in Clouds," NACA RM E51G05, 1951.

119. Lewis, W., Perkins, P. J., and Brun, R. J., "Procedure for Measuring Liquid-Water Content and Droplet Sizes in Supercooled Clouds by the Rotating Multi-Cylinder Method," NACA RM E53D23, 1953.

120. Loughborough, D, L., "The Density of Ice Collected on Rotating Cylinders," B. F. Goodrich Research Report, Prob. No. P15.01, July 29, 1946.

121. Lozowski, E. P., Stallabrass, J. R., and Hearty, P. F., "The Icing of an Unheated Non-Rotating Cylinder in Liquid Water Droplet - Ice Crystal Clouds," National Research Council of Canada Report, LTR-LT-96, February 1979.

122. Magenheim, B. and Rocks, J. K., "Development and Test of a Microwave Ice Accretion Measurement Instrument (MIAMI)," NASA CR-3598, 1982.

123. Magenheim, B. and Rocks, J., "A Microwave Ice Accretion Measurement Instrument (MIAMI)," AIAA Paper 82-0385, Journal of Aircraft, May 1983.

124. Malkus, V. R. W., Bishop, R. D., and Briggs, R. O., "Analysis and Preliminary Design of an Optical Instrument for the Measurement of Drop Size and Free-Water Content of Clouds," NACA TN 1622, June 1948.

125. May, K. R., "The Cascade Impactor: an Instrument for Sampling Coarse Aerosols," Journal Scientific Instruments, Vol. 22, No. 10, pp. 187-195, October 1945.

126. McCullough, S. and Perkins, P. J., "Flight Camera for Photographing Cloud Droplets in Natural Suspension in the Atmosphere," NACA RM E50K01a, 1951.

127. McTaggart-Cowan, J. D., Lala, G. G., and Vonnegut, B., "Design, Construction and Use of an Ice Crystal Counter for Ice Crystal Cloud Studies by Aircraft," Journal of Applied Meteorology, Vol. 9, No. 2, pp. 294-9, April 1970.

128. Moyle, M. P., Churchill, S. W., Tribus, M., and Stubbs, H. E., "Development and Evaluation of an Icing Indicator," Paper Number 56-AV-1, 434-56, December 30, 1955.

129. Neel, Jr., C. B., and Steinmetz, C. P., "The Calculated and Measured Performance Characteristics of a Heated-Wire Liquid-Water-Content Meter for Measuring Icing Severity," NACA TN 2615, 1952.

130. Neel, C. B., "A Heated-Wire Liquid-Water-Content Instrument and Resultsof Initial Flight Test in Icing Conditions," NACA RM A54I23, 1955.

131. Norment, H. G. and Zalosh, R. G., "Effects of Airplane Flowfields on Hydrometeor Concentration Measurements," AFCRL-TR-74-0602, AD-A006-690, December 6, 1974.

132. Norment, H. G., "Collection and Measurement Efficiencies of the Ewer Cloud Water Meter for Hydrometeors," AFGL-TR-79-0122, May 11, 1979.

133. Norment, H. G., "Effects of Airplane Flowfields on Cloud Water Content Measurements," A/C 70-214, April 30, 1975.

134. Norlnent, H. G., Quealy, A. G., and Shaw, R. J., "Three-Dimensional Trajectory Analysis of Two Drop Sizing Instruments: PMS OAP and PMS FSSP," AIAA-87-0180, Presented at the AIAA 25th Aerospace Sciences Meeting, Reno, NV, January 12-15, 1987.

135. Olsen, Jr., W.A., Takeuchi, D., and Adams, K., "Experimental Comparison of Icing Cloud Instruments," NASA JM83340, AIAA Paper 83-0026, 1983.

136. Pagliuca, S., "Icing Measurements on Mount Washington," Journal of the Aeronautical Sciences, No. 4, pp. 399-402, 1937.

137. Pearson, J. E. and Martin, G. E., "An Evaluation of Raindrop Sizing and Counting Techniques," McDonnell Douglas Corporation.

138. Perkins, P. J., "Flight Instrument for Measurement of Liquid-Water- Content in Clouds at Temperatures Above and Below Freezing," NACA RM E50J12a, 1951.

139. Perkins, P. J., McCullough, S., and Lewis, R. D., "A Simplified Instrument for Recording and Indicating Frequency and Intensity of Icing Conditions Encountered in Flight," NACA RM E51E16, 1951.

140. Pettit, K. G., "On the Measurement of the Properties of Supercooled Clouds," NRC DME/NAE Quarterly Bulletin 1954(2), April-June 1954.

141. Pettit, K. G., "Nephelometric Instrumentation for Aircraft Icing Research," NRC Report MD 33, 1950.

142. Pettitt, J. W., "Qualification Tests of Cook Ice Detector Assembly, P/N666-1221," WADC-TN-WCLP-54-196, AD-855-968/4, Oct. 27, 1954.

143. Pinnick, R. G., Garvey, D. M., and Duncan, L. D., "Calibration of Knollenberg FSSP Light-Scattering Counters for Measurement of Cloud Droplets," Journal of Applied Meteorology, Volume 20, 1981, pp. 1049-1057.

144. Plank, V. G., Berthel, R. 0., and Barnes, Jr., A. A., "An Improved Method for Obtaining the Water Content Values of Ice Hydrometeors from Aircraft and Radar Data," J. Appl. Meteorol., 19(11), pp. 1293-9, November 1980.

145. Profio, R. and Vickers, W. W., "Investigation of Optimal Design for Supercooled Cloud Dispersal Equipment and Techniques. Final Report, Dec. 1962 - March 1963," T0-B-64-32, AFCRL-64-427, AD-601-173, February 1964.

146. Quist, S. M., "Rosemount Ice Detector Mounting and Location," RMT 37314A,Jan. 1, 1973.

147. Rays, G. P., "Airborne Instrumentation System for Measuring Meteorological Phenomena Inside Thunderstorms," Armed Services Technical Information Agency, Technical Documentary Report No. ASD-TDR-63-231, May 1963.

148. Ringer, T. R. and Stallabrass, J. R., "The Dynamic Ice Detector for Helicopters," AGARD Conference Proceedings No. 236, Icing Testing for Aircraft engines, Paper 8, 1978.

149. Rudman, J. and Biff, F. J., "Some Notes on the Design and Performance of a Thermal Water Content Meter for use in Cloud," RAE TN ME 145, 1953.

150. Rush, C. K. and Wardlaw, R. L., "Icing Measurements with a Single Rotating cylinder," NRC Report LR-206, September 1957.

151. Schaefer, V. G., "An Air Decelerator for Use on De-Icing, Precipitation-Static and Weather-Reconnaissance Planes," General Electric Co., January 1945.

152. Schaefer, V. J., "Report on General Electrical Cloud Meter," Basic Icing Research by General Electric. Co., Fiscal Year 1946, U. S. Air Forces, Tech. Rept. 5539, 1947.

153. Schaefer, V. J., "Demountable Rotating Multi-Cylinders for Measuring Liquid Water Content and Particle Size of Clouds in Above and Below Freezing Temperatures," Basic Icing Research by General Electric Co., Fiscal Year 1946, U. S. Air Forces, Tech. Rept. 5539, 1947.

154. Schaefer, V. J., "The Preparation and Use of Water Sensitive Coatings for Sampling Cloud Particles," Basic Icing Research by General Electric Co., Fiscal Year 1946, U. S. Air Forces, Tech. Rept. 5539, 1947.

155. Shaw, R. J., Norment, H. G., and Ouaely, A., "The Use of a Three-Dimensional Water Droplet Trajectory Analysis to Aid in Interpreting Icing Cloud Data," AIAA-86-0405, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

156. Simila, A., "A Practical Method of Forecasting Icing by Means of Aero-logic Measurements," Finland, Ilmatieteelisen Keskuslaitoksen Toimituksia, No. 22, 1944.

157. Skatskiy, V. I., "Aircraft Gauge of Water Content of Liquid- Droplet Clouds," News of the USSR Academy of Sciences, Geophysical Series, No. 9, 1963.

158. Skidmore, E. W., et al, "Cloud Liquid Water Content Measuring Equipment for the Nomad M24 Aircraft Flight Icing Trials of 1970-1972," ARL-MECH- ENG-NOTES 391, AD-A130-970/7, Sept. 1, 1981.

159. Smith, R. B., "On the Usefulness of Cylinder Collection Efficiency Curves for Rare Drop Size Distributions," Harvard-Mt. Washington Icing Research Report 1946-1947, U. S. Air Materiel Command, Tech. Rept. 5767.

160. Smith, R. B., "Development and Testing of an Instrument for Measuring Snow Content of the Air," Harvard-Mt. Washington Icing Research Report 1946-1947, U. S. Air Materiel Command, Tech. Rept. 5676.

161. Stallabrass, J. R. and Hearty, P. F., "Icing Instrumentation - The Ice Detection Problem," Gas Turbine Operations and Maintenance Symposium, NRC Associate Committee on Propulsion, October 1974.

162. Stallabrass, J. R., "An Appraisal of the Single Rotating Cylinder Method of Liquid Water Content Measurement," NRC Report LTR-LT-92, November 1978.

163. Stallabrass, J. R., "Helicopter Ice Detection, Icing Severity and Liquid Water Content Measurement," AGARD Advisory Report No. 127, Aircraft Icing Paper 2, 1977.

164. Stallabrass, J. R., "Comparison of Droplet Size Measurements by Three Methods," National Research Council, Third International Workshop on Atmospheric Icing of Structures, Vancouver, B. C., Canada, May 6-8, 1986.

165. Stallabrass, J. R., "Review of Icing Detection for Helicopters," NRCReport LR-334, March 1962.

166. Strapp, J. W. and Schemenauer, R. S., "Calibrations of Johnson-Williams Liquid Water Content Meters in a High Speed Icing Tunnel," Journal of Applied Meteorology, Vol. 21, No. 1, January 1982.

167. Takeuchi, D. M., Jahnsen, L. J., Callander, S. M., and Humbert, M. C.,"Comparison of Modern Icing Cloud Instruments," NASA CR-168008, 1983.

168. Tolefson, H. B., "Flight Measurement of Liquid-Water-Content of Clouds and Precipitation Regions," XC-35 Research Project Bulletin, No. 9, NACA Bulletin No. L4E17, May 1944.

169. Turner, F. M., Radke, L. F., and Hobbs, P. V., "Optical Techniques for Counting Ice Particles in Mixed-Phase Clouds," Atmospheric Technology (USA), No. 8, pp. 25-31, Spring 1976.

170. Underwood, E. B., "Instrumentation and Operations for Gathering Thunderstorm Data with an F-100F Aircraft During the 1963 National Severe Storm Project," ASD-TDR-64-77, AD-435-006, February 1964.

171. Vickers, R. S., Heighway, J., and Gedney, R,, "Airborne Profiling of Ice Thickness Using a Short Pulse Radar, NASA TM X-71481, 1973.

172. Von Glahn, U. H., Celder, T. F., and Smyers, Jr., W. H., "A Dye-Tracer Technique for Experimentally Obtaining Impingement Characteristics of Arbitrary Bodies and a Method for Determining Droplet Size Distribution," NACA TN 3338, 1955.

173. Vonnegut, B., "A Capillar Collector for Measuring the Deposition of Water Drops on a Surface Moving Through Clouds," Review of Scientific Instruments, No. 20, pp. 110-114, February 1949.

174. Vonnegut, B., Cunningham, R. M., and Katz, R. E., "Instruments for Measuring Atmospheric Factors Related to Ice Formation on Airplanes," M.I.T., Dept. of Meteorology, De-Icing Research Lab., 1946, U. S. Air Force TR 5519, August 1946,

175. Warner, E. V., "Helicopter Rotor-Blade Ice Detection," U. S. Army Transportation Research Command, Fort Eustis, TCRED Technical Report 61-98, August 1961.

176. Wexler, R., "Optimum Wavelength for Storm Detection Through Rain,"Belmar, N. J., Evans Signal Laboratory, TM No. M1004, September 1946.

177. Wherry, D. M., "Rotating Disc Icing Rate Meter," U. S. Air Materiel Command, Aeronautical Ice Research Laboratory, Engineering Rept., Serial No. AIRL 46-67-1P, June 1947.

178. Wright, G. M., "An Aircraft Icing-Rate Meter," NAE, Canada, LR66, June1953.

179. Zaytsev, V. A. and Ledokhovich, A. A., "Instruments and Methods of Cloud Study from Aircraft," (Translation) Gidrometeoizdat, 1960.

CHAPTER VIII

SECTION 4.0

AIRCRAFT ICE FORMATION

BIBLIOGRAPHY

VIII.4.0 AIRCRAFT ICE FORMATION

1. "Aircraft Icing," Advisory Group for Aerospace Research and Development, AGARD-AR-127, AD-A063-794/2SL, November 1978.

2. "Aircraft Icing," NASA CP-2086, 1979 (Also FAA-RD-78-109).

3. "Card File on Ice Formation," U. S. Library of Congress, Aeronautics Division.

4. "Forecasting Aircraft Icing for Long-Distance Flights," Forecasters' Bulletin No. C-14, 2nd Wea. Mg., January 1959.

5. "Ice Formation," U. S. Works Progress Administration, Part III, Bibliography of Aeronautics, Part 21, Compiled from the Index of Aeronautics of the Institute of the Aeronautical Sciences, New York, pp. 34-43, 1937.

6. "Ice Formation on Aircraft," U. S. Navy Dept., Bureau of Aeronautics, Washington, Aerology Ser., No. 1, 1943.

7. "Ice Formation on Wings and Other Structural Parts of Aircraft," U. S. National Advisory Committee for Aeronautics, Preliminary Report, Washington, D. C., 1928.

8. "Icing Committee Studies," Comite d'Etudes du Givrage, BST No. 85, March 1939.

9. "Icing Research with RY3 Aircraft JT973 Icing Season 1945-1946," Nat. Res. Council, Canada, LT. Lab Note 7-46, June 1946.

10. "Low Velocity Icing Investigation," Report AIRL 6137 51-7-1, U. S. Air Force, November 1951.

11. "Report of Ice Formation on Aircraft," French Committee for the Study of Ice Formation, NACA TM 919, 1938.

12. "Standard Classification for Types of Aircraft," Paris, International Civil Aviation Organization, 3rd Session of the Meteorological Division, Final Report, March 1950, Publ. in Montreal, Canada, pp. 136-143, May 1950.

13. "Study of the Physical Aspects of Ice Formation," Central Meteorological Observatory Report, 31, No. 3, Japan, March 1950.

14. "Summary of C-54A Flights on Icing Conditions," Report No. C54A-1999XIR, December 1945.

15. Andrus, C. G., "Ice Formation on Aircraft," Chapter 13, Aeronautical Metrology, 2nd. Edition, by W. R. Gregg, The Ronald Press Co., 1930.

16. Benson, Thomas, Woratschek, and Stewart, "Icing Evaluation, U-21A Airplane with Low Reflective Paint, Final Report," USAAEFA-77-05, May 1977.

17. Bergrun, N. R., "Genera. Results of NACA Flight Research in Natural Icing Conditions During the Winter of 1945-46," Astronaut. Engr. Review, January 1948.

18. Bergrun, N. R., "General Results of NACA Flight Research in Natural Icing Conditions During Winters of 1945 and 1946," NACA, 1946.

19. Blatz, R. E., "Low Velocity Icing Investigation," AF 33-038-7947, AD-2289, November 1951.

20. Bleeker, W., "The Formation of Ice on Aircraft," NACA TM No. 1027, August 1942.

21. Boelter, L. M. K., "Final Report - Icing Studies," Univ. of California, Los Angeles, Calif., Contract W-33-038-ac-13489, August 1946.

22. Bolley, E., "Icing on Aircraft," New York-London, Handbook of Metrology, 1945.

23. Bowden, D. T., Gensemer, A. E., and Skeen, C. A., "Engineering Summary of Airframe Icing Technical Data," FAA Technical Report ADS-4, 1964, AD-608- 865.

24. Bragg, M. B. and Gregorek, G. M., "An Analytical Evaluation of the Icing Properties of Several Low and Medium Speed Airfoils," AIAA-83-0109, January 1983.

25. Bragg, M. B., Gregorek, G. M., and Shaw R. J., "An Analytical Approach to Airfoil Icing," AIAA Paper 81-0403, 1981.

26. Brock, G. W. and Luck, E. C., "Meteorological Problems in Jet Aircraft Icing," USAF Tech. Rept., 1952.

27. Burgslnueller, W., et al, "Aerodynamic Investigations to Determine Possible Ice Flight Paths," NASA TM-76648, N82-27235/2, March 1, 1982.

28. Carroll, T. and McAvoy, W. H., "The Formation of Ice Upon Exposed Parts of an Airplane in Flight," NACA TN 293, 1928.

29. Carroll, T. and McAvoy, W. H., "The Formation of Ice Upon Airplanes in Flight," NACA TN 313, 1929.

30. Chernenko, Zh. S., Maksiutinskii, P. F., and Vasilenko, V. P., "Icing of the Fuel System Elements of Jet Aircraft," Samoletostroenie i Tekhnika Vozdushnogo Flota, No. 14, pp. 125-128. In Russian.

31. Cheverton, B. T., "Icing Flight Development," Journal of R.A.S., Vol. 63, No. 587, 1959.

32. Cheverton, B. T., "The Aircraft Icing Hazard," The Engineer, Vol. 216, pp. 183-185, August 2, 1963.

33. Ciccoti, J. M., and Jailer, R. W., "A Mission-Oriented Analysis of Aircraft Icing-An Extension of Methodology," WADC-TR-57-60, AD-118-016, December 1956.

34. Clouston, A. E., "Report of Icing of D. H. Comet G-ACSS During London- Cape-London Flight, 13.11.37-20.11.37," GB Meteorological Office Library, 1937.

35. Cocheme, J., "Note on Some Cases of Aircraft Icing," London, Meteorological Magazine, No. 77, pp. 33-38, 1948.

36. Dentan, J., "The Formation of Ice on Aircraft," L'Aeronautique, No. 20, pp. 183-193, 207-220, Sept. - Oct. 1938, Abstract in Journal of the Aeronautical Sciences, No. 6, pp. 123, 1939.

37. Derek, M., "Icing Trials," Shell Aviation News, No. 171, Sept. 1951.

38. Dickey, T. A., "An Analysis of the Effects of Certain Variables in Determining the Form of an Ice Accretion," AEL 1206, (presented at Mt. Washington Spring Planning Conference, April 1952, Aeronautical Engineering Laboratory, Naval Air Experimental Station, May 29, 1952).

39. Diem, M., "Contributions to the Problem of Ice Formation," (Translation) U. S. Air Force Translation, No. F-TS-533-RE, May 1946.

40. Dietenberger, M. A., "A Model for Nocturnal Frost Formation on a Wing Section - Aircraft Takeoff Performance Penalties," NASA CR-3733, N83-36598/1, Oct. 1, 1983.

41. Dixon, W. A., "Watch Out for Ice," Skyways Magazine, Vol. 9, pp. 26-27, December 1950.

42. Dunbar, R. M., "Icing Tests of B-47 Vortex Generators," WADC Technical Report 53-51, March 1953.

43. Eredia, F., "The Formation of Ice on Airplanes," Rivista di Meterologia Aeronautica, 3(2), pp. 46-83, 1939.

44. Evanich, P. L., "NASA Lewis Research Center's Icing Research Program. Proceedings: Fifth Annual Workshop on Meteorological and Environmental Inputs to Aviation Systems," NASA CP-2192, 1981.

45. Fairhead, I. F., "Cold Weather Engineering Trials," Aeroplane and Armament Experimental Establishment, Boscombe Down, England, Rept. AAEE/931/2-PT-6, AD-482-533L, February 1966.

46. Findeisen, W. and Walliser, S., "Experimental Evidence Supporting the Dependence of the Icing Limit Upon Flying Speed," U. S. Air Force Translation No. 405, 1943.

47. Fischer, C., "Icing - No Problem for the DO 132," Dornier-Post, English Edition, No. 4, pp. 26-29.

48. Golovkov, M. P., "Investigation of Ice Formed on Airplanes," Akademiia Nauk, USSR, Isvestiia, Ser. Georgr. i Geofiz., No. 1, pp. 119-134, 1940, summary in English.

49. Gunn, R., "In-Flight Icing of Highly Electrified Aircraft," Journal of the Aeronautical Sciences, 14(9), pp. 527-528, September 1947.

50. Hansen, A., "Unusual Type of Ice Formation on Airplane," (Translation), Hergesell Band, March 1932.

51. Hebner, E., "The Jeopardizing Action of Ice Formation on Airplanes," Report No. 25 of the German Meteorological Service, Published by the Lindberg Aeronautical Observatory, District of Beeskow, 1928.

52. Herald, R. G., "Photographs Obtained During Icing Evaluation Tests," WADCTN WCT 53-58, September 1954.

53. Hillendahl, W. H., "A Flight Investigation of the Ice-Prevention Requirements of the United States Naval K-Type Airship," NACA Wartime Report A-4, October 1945.

54. Hinton-Lever and Chick, N. R., "Vanguard Icing Encounter," Aircraft Ice Protection Conference, 1962.

55. Hogan, J., "Ice Accretion on Aircraft in Australia," Bureau of Metrology Bulletin, Australia, No. 26, 1940.

56. Hufnagel, S., "Danger of Aircraft Icing at Temperatures Above 32 Degrees F," Wehrtechnik, No. 11, pp. 499-502, November 1970.

57. Humphreys, W. J., "Supersaturation and Icing of Airplanes," Monthly Weather Review, Vol. 58, No. 245, June 1930.

58. Irisov, A. S., "Physical Conditions of the Icing of Aircraft," Transactions of the Zhukov Air Academy, Issue 52, 1939.

59. Jailer, R. W. and Ciccotti, J. M., "Aircraft Operation in Icing Weather," WADC Technical Note 55-256, AD-80238, June 1955.

60. Jones, R. F., "Analysis of Reports of Ice Accretion on Aircraft," MRP1017, AD-139-538, London, November 23, 1956.

61. Jones, R. F., "Ice Formation on Aircrafts," World Meteorological Organ. (WMO No. 109. tp. 47), Tech. Note 39, 1961.

62. Kanter, M., "Flight Performance on XB-25E Airplane No. 42-32281 in Natural Ice During February, March and April 1945," AAF TR No. 5403, Air Materiel Command, Army Air Forces, December 17, 1945. (Available from Office of Technical Services, U. S. Dept. of Commerce, as PB No. 27065).

63. Khragian, A. Kh., Fomii, N. P., et al, "Icing of Aircraft," Redizdat of the Civil Air Fleet, M., 1938.

64. Kingery, W. D., "Summary Report - Project Ice Way," Air Force Cambridge Research Labs., AFCRL-62-498, May 1962.

65. Kleuters, W., "Some Recent Results on Icing Parameters," AGARD Advisory Rep. No. 127, paper 1, September 30, 1977, Publ. 1978.

66. Kopp, W., "Danger of Ice Formation on Airplanes," NACA TM No. 499, 1929.

67. Lebedev, N. V., "Combating Ice on Aircraft," Extract: The Processes of Ice Formation on Aircraft and Methods of their Investigation, Moscow-Leningrad, 1939, M.A.P., R.T.P. Translation No. 1523.

68. Leckman, P. R., "Qualification of Light Aircraft for Flight in Icing Conditions," Society of Automotive Engineers Paper No. 710394, 1971.

69. Lewis, W. and Hoecker, Jr., W, H., "Observations of Icing Conditions in Flight During 1948," NACA TN No. 1904, June 1949.

70. Lewis, W., "Icing Conditions to be Expected in the Operation of High Speed, High Altitude Airplanes," NACA Conference on some Problems of Aircraft Operation, Nov. 17-18, 1954, NACA Lecture 20, 1955.

71. Lucking, D. F, "Indication, Measurement and Control of Ice Accretion," Royal Aero. Soc. Journal, Vol. 5, pp. 382-385, June 1951.

72. Mason, D., "Aircraft and Icing Research - I and II," Weather, Vol. 8, No. 8, pp. 243-246, Aug. 1953, Weather, Vol. 8, No. 9, pp 261-267, September 1953.

73. Mason, D., "British European Airways Icing Trials," Shell Aviation News, No. 171, September 1952.

74. Mathews, W. R., "Model QM-50C Drone Under Controlled Temperature and Icing Conditions," Naval Air Test Center, ST363 96R64, AD-451-677L, October 1964. (Release only to U. S. Government Agencies is authorized. Other certified requesters shall obtain release approval from Bureau of Naval Weapons, Navy Dept., Wash. 25, D. C.).

75. Mazin, I. P., "Physical Bases of Icing of Aircraft," (Translation) Gidrometeoizdat, 1957.

76. McBrien, R. L., "Icing Problems in Operation of Transport Aircraft," SAE, Transactions, No. 49, pp. 397-408, 1941.

77. Mihail, A., "Note on the Subject of Icing of Airframes," Association Technique Maritime et Aeronautics, Bulletin, No. 67, pp. 177-204, In French.

78. Minser, E. J., "A Report of Ice Accretion on March 5, 1943," Trans-continental and Western Air, Inc., Meteorological Dept., Tech. Note No. 7, July 1943.

79. Minser, E. J., "Studies of Synoptic Free-air Conditions for Icing of Aircraft," American Meteorological Society, Bulletin No. 19, pp. 111-122, 1938.

80. Minser, E. J., "Icing of Aircraft," American Meteorological Society, Bulletin No. 16, pp. 129-133, May 1935, Transcontinental and Western Air, Inc., Meteorological Dept. Tech. Note, No 1, Rev. November 7, 1942.

81. North, D., "Summary of DC-3 Flights in Icing Conditions During Winter of 1944-1945," American Airlines, Inc., Engineering Dept., N. Y., Rept. No. DC-3-1999XIR.

82. North, H. and Polte, W., "The Formation of Ice on Airplanes," NACA TM786, February 1936.

83. Olsen, W., Walker, E., Sotos, E., "Close-Up Movies of the Icing Process," NACA Film C-313198.

84. Parkin, J. M., "North Atlantic Air Service. The Ice Hazard, Appendix XII," Montreal, Engineering Journal, No. 20, pp. 611-647, 1937.

85. Payne, C. E. G. and Pitts, G. F., "Proteus Icing Experience," Aircraft Ice Protection Conference, June 1959.

86. Perkins, P. J., "Icing Frequencies Experienced During Climb and Descent by Fighter-Interceptor Aircraft," NACA TN 4314, July 1958.

87. Perkins, P. J., Lewis, W. and Mulholland, D. R., "Statistical Study of Aircraft Icing Probabilities at the 700 and 500 Millibar Levels Over Ocean Area in the Northern Hemisphere," NACA TN 3984, 1957.

88. Rapp, R. R., "Aircraft Icing During Low-Level Flights," RAND/N-1311-AF,AD-A078-843/0, Nov. 1, 1979.

89. Riley, J. A., "Aircraft Icing Zones on the Oakland-Cheyenne Airway," Monthly Weather Review, No. 65, pp. 104-108, 1937.

90. Ritz, L., "Ice Formation," Jahrbuch der Deutschen Luftfahrtforschung Ergunzungsband, pp. 106-111, 1938.

91. Robitzsch, M., "The Icing of Aircraft," NACA TM 1028, September, 1942.

92. Rodert, L. A,, "Physical and Operational Aspects of Aircraft Icing," Compendium of Meteorology, pp. 1190-1196, AMS, Boston, 1951.

93. Rodert, L. A., "Physical Aspects of Aircraft Icing," American Meteorological Society, Compendium of Meteorology, 1950.

94. Rossi, and Veikko, "Glazing and Icing of Aircraft," Zeitschrift furAngewandte Meteorologie, No. 55, pp. 48-51, 1938.

95. Rush, C. K., "Icing Problems of High Speed Aircraft," Napier Aircraft Ice Protection Conference, May 1960.

96. Sand, W. R., "Aircraft Icing Conditions - Normal and Unusual," Paper Presented at the 19th JALC Air Law Symposium, 1985.

97. Sanderson, Janet I., "Occurrence of Ice in the Form of Glaze, Rime, and Hoarfrost with Respect to the Operation and Storage of V/STOL Aircraft," AD-A001-46O/5, Jan. 1, 1973.

98. Schaefer, V. J., "Final Report on Icing Research up to July 1, 1946," Basic Icing Research by General Electric Co., Fiscal Year 1946, U. S. Air Forces Tech. Rept. 5539, 1947.

99. Schaefer, V. J., "Part I. Laboratory, Field, and Flight Experiments," General Electric Research Lab., Final Rept., Project Cirrus, Rept. No. RL-785, March 1953.

100. Schaetzel, S. S., "A Rapid Method of Estimating the Severity of Icing," Aircraft Engineering, Vol. 22, No. 258, 1950.

101. Schaetzel, S. S., "Icing Problem," Flight, Vol. 60, pp. 246-248, August 1951.

102. Scheuer, J. C., "(U) F-1O2 Icing Tests," WADC TN 55-289, August 1955.

103. Scott, M., "Ice Formation on Aircraft and Its Prevention," J. of the Franklin Institute, November 1930.

104. Serbein, D., "Certain Aspects of Aircraft Icing in the Alaskan-Aleutian Area," American Meteorological Society, Bulletin No. 26, pp. 419-425, 1945.

105. Severo, G., "Formations of Ice on Airplanes in Flight," Revista Meteorologica, 1(3), pp. 54-66, July 1942.

106. Shaw, R. J., et al, "An Experimental Study of Airfoil Icing Characteristics," NASA TM 82790, Jan. 1, 1982.

107. Shaw, I. B., "Aircraft Icing at Very Low Temperatures," Meteorol. Mag. 83, No. 987, 1954.

108. Simpson, G. C., "Ice Accretion on Aircraft, Notes for Pilots," H. M. Stationary Office, 1939, Prof. Notes No. 82, GB Met. Office, 1942.

109. Smith, L. D., "To Run When They Want to, Planes Must Handle the Maximum Icing Conditions," SA J., Vol. 78, No. 6, pp. 39, June 1970.

110. Smyth, R., "Flight in Ice," Canadian Aviation, Vol. 25, Nos. 3-4, Toronto, March-April 1952.

111. Snell, W. E. and Hannon, P. G., "Icing on Aircraft," California Institute of Technology, Meteorological Dept., February 1942.

112. Spencer, K. T., "Aircraft Icing," London, Journal of Glaciology, No. 1, pp. 68-69, 1947.

113. Speranza, F., "The Formation of Ice," Rivista di Meteorologia Aeronautica, 1(2), pp. 19-30, 1937.

114. Steiner, R. O., "The Icing of Airplanes," Meteorological Zeitschrift, Vol. 47, 1930.

115. Stickley, A. R., "Some Remarks on the Physical Aspects of the Aircraft Icing Problems," Journal of the Aeronautical Sciences, No. 5, pp. 442-446, 1938.

116. Svensson, T., "Data on Ice Formation on Airplanes," (Translation) Flying, No. 20B, October 1940.

117. Thompson, J. K., "Frost on Parked Aircraft," WADC Tech. Note 57-197, AD-118-313, July 1957.

118. Thompson, J. K., "Proposed Standard for Describing Aircraft Icing," WADC TN 56-516, December 1956.

119. Trunov, O. K. and Egorov, M. S., "Some Results of Experimental Flights in Natural Icing Conditions and Operation of Aircraft Thermal Ice-Protection Systems," (Translation) National Research Inst. for Civil Air Fleet, USSR, 1957.

120. Trunov, O. K. and Kharikov, A. A., "Questions of Icing on Aircraft," Redizdat, Aeroflot, 1954.

121. Trunov, O. K., "Results of Experimental Flights in Conditions of Icing Report on the International Conference on Problems of Icing," Redizdat, [?] Aeroflot, 1960.

122. Trunov, O., "Icing of Aircraft and the Means of Preventing It," English Translation, FTD-M7-65-490, p. 105, 1965.

123. Viaut, A., "Study on Ice Formation," La Meteorologie, 3 Ser., pp. 159-186, 1959.

124. Ward, R. K., "Flight Through Ice," Flying Safety, Vol. 9, October 1953.

125. Wegener, K., "Icing on Aircraft," Meteorologische Zeitschrift, No. 47, pp. 145-147, April 1930.

CHAPTER VIII

SECTION 5.0

PROPELLER ICING

BIBLIOGRAPHY

VIII.5.0 PROPELLER ICING

1. "Aircraft Propeller Handbook," Air Force Systems Command, ANC-9, September 1956.

2 "Airscrew De-Icing," Flight Magazine, Vol. 61, March 1952.

3. "De-Icer Units for Propeller Planes," Battelle Memorial Inst., AAF, Air Technical Service Command, Engr. Div., S-660-2, January 1946.

4. "De-Icing Effectiveness of External Electric Heaters for Propeller Blades," NACA TN 1528, February 1945.

5. "Effect of Thermal De-Icing Tip Orifices on Propeller Performance," Curtiss-Wright Corp., Propeller Div., Rept. No. C-1762-1946, TPPD Sec., November 1946.

6. "Effects of Propeller Icing on Airplane Performance and Vibration," Curtiss-Wright Corp., March 1950.

7. "Flight Test of 50-Inch Blade Heaters (HSP Number 70101) on 23E50/6491A-0 Propeller," Hamilton Standard Propeller Div., Rept. No. HSP-547, January 1947.

8. "Flight Tests to Determine the Effect of Rubber Fluid De-Icing Boots on Propeller Performance in Level Flight Conditions," Curtiss-Wright Corp., Propeller Div., Engr. Dept., Aerodynamics Section, Rept. No. C-1794, February 1947.

9. "Hydromatic Propellers: Electric De-Icing System," Hamilton Standard Propellers, No. 171, 1948.

10. "Icing Tests Flights of Curtiss No. 125171-1 Propeller De-Icing Shoes on DC-6 Airplane NX-90725," Report No. DC-6-1934X1R, American Airlines, Inc., April 14, 1948.

11. "Kinetic Temperature of Propeller Blades in Conditions of Icing," Report No. Mech. Eng. 2, Royal Aircraft Establishment, May 4, 1948.

12. "Propeller De-Icing Tests, C-632S-A," Curtiss-Wright Corp., Rept. No. C-1907, 1947.

13. "Propeller Systems, Aircraft, General Specification For, Amendment 1," MIL-P-76366A, Sept. 1, 1977.

14. "Propellers for the Rolls Royce Dyne," Society of Licensed Aircraft Engineers Journal, Vol. 11, No. 9, 1963.

15. "Service Test Installation of Propeller Electrical De-Icing System," AAF Air Technical Service Command, Engr. Div., Wright Field, Ohio, January 1946.

16. "Specification for Installation of ..uminum Blade De-Icing Assemblies," Hamilton Standard Propellers, HSP No. 52, 1948.

17. "Spray Ba: De-Icing Test of 23260/2H17B3-48R Propeller on C-46F Airplane," Hamilton Standard, Propellers Div., Rept. No. HSP-559, May 1947.

18. "Thermal Anti-Icing Test DC-6 Airplane Equipped with Hamilton Standard 731 Blade Heaters," United Air Lines, Rept. No, SFOT-086, 1948.

19. Babbit, J. D., Rose, D. C., and Orr, J. L., "Thermo-Electric Airscrewne-Icing," Nat. Res. Council, Canada, Rept. No. MD-8, September 1940.

20. Babbitt, J. D. and Rose, D. C., "Observations on an Electrical Method for the De-Icing of Aeroplane Propellers," NRC Report MD-6 (PHC-153), October 1939.

21. Bass, R. M., "The Measured Effect of Icing on Propeller Performance," Performance Office Report No. 1973, Dowty Rotol Limited, Gloucherster, England.

22. Bragg, M. B. and Gregorek, G. M., "Icing Analysis of Two Propeller Sections," AARL TR 8302, Ohio State University, May 1983.

23. Brown, C. D., "Weight Analysis of N.R.C. Electro-Thermal Propeller De-Icing Equipment," Nat. Res. Council, Canada, L. T. Note 4-45, March 1945.

24. Clay, W. C., "The Prevention of Ice Formation on Propellers," NACA ACR, October 1937.

25. Colclough, W. J., "Environmental Influences on Testing Composite Propeller Blades," Dowty Rotol Limited, Gloucestershire, England.

26. Cooper, J. P., "The Linearized Inflow Propeller Strip Analysis," WADC TR56-615, March 1957.

27. Corson, Jr., B. and Maynard, J. D., "Analysis of Propeller Efficiency Losses Associated with Heated-Air Thermal De-Icing," NACA TN-1112, July 1946.

28. Corson, Jr., B. and Maynard, J. D., "Investigation of the Effect of a Tip Modification and Thermal De-Icing Airflow on Propeller Performance," NACA TN-1111, July 1946.

29. Corson, Jr., B. W. and Maynard, J. D., "The Effect of Simulated Icing on Propeller Performance, NACA TN 1084, 1946.

30. Eck, "Propeller Icing and Its Prevention," AAF Translation No. 517, F-ts-517-RE, April 22, 1946.

31. Gershzohn, M., "Propeller Icing," Journal of Aeronautical Meteorology, 2(1), pp. 13-17, October 1945.

32. Goldstein, S., "On the Vortex Theory of Screw Propellers," Proceedings of the Royal Aeronautical Society (London), Ser. A, Vol. 123, No. 792, April 6, 1929.

33. Gray, V. H. and Campbell, R. G., "A Method for Estimating Heat Requirements for Ice Prevention on Gas-Heated Hollow Propeller Blades," NACA TN 1494, 1947.

34. Gray, V. H., "Heat Requirements for Ice Prevention on Gas-Heated Propellers," Presented at SA Annual Meeting, January 9-13, 1950, SA Preprint No. 424.

35. Gray, W. H. and Davidson, R. E., "The Effect of Tip Modification and Thermal De-Icing Airflow on Propeller Performance as Determined from Wind Tunnel Tests," NACA TN 1540, February 1944 (update).

36. Haines, A. B., "Comparative Tests on Propellers with Simulated Ice and with De-Icing Overshoes in 24-Foot Tunnel," ARC R&M No. 2397, 1946.

37. Hayward, A. J. and Majy, A. G., "De-Icing Tests on A.S.M. D8 Propeller at the National Research Council, Ottawa, Canada - Winter 1957-1958," Rotol Limited Development Department Report No. 073.1.103, July 23, 1958.

38. Jensen, E. W., "Power Plant Ice Protection Model 377, Boeing D 8209, #9," March 1947.

39. Korkan, K. D., "Performance Degradation of Propeller/Rotor Systems Due to Rime Ice Accretion," NASA Lewis Research Center Icing Analysis Workshop, March 1981.

40. Korkan, K. D., nadone, L., and Shaw, R. J., "Performance Degradation of Propeller Systems Due to Rime Ice Accretion," AIAA J. of Aircraft, Vol. 21, No. 1, January 1984. (Also Vol. 19, No. 1, January 1982.)

41. Korkan, K. D., Gregorek, G. M., and Mikkelson, D. C., "A Theoretical and Experimental Investigation of Propeller Performance Methodologies," AIAA Paper 80-1240, June 1980.

42. Kuhring, M. S., "Further Investigation of the Possibility of Preventing Ice Formation on the Propellers of Aircraft by Utilization of Exhaust Heat," NRC Report PAE-27, June 1938.

43. Kuhring, M. S., "Investigation of the Possibility of Preventing Ice Formation on Wings and Propellers of Aircraft by the Utilization of Exhaust Gas," NRC Report PAE-19 (also MD-1), May 1935.

44. Laughlin, W., "Propeller Electrical De-Icing System for the P-82Airplane," AAF TN 5442, March 1946.

45. Lewis, J. P. and Stevens, Jr., H. C., "Icing and De-Icing of a Propeller with Internal Electric Blade Heaters," NACA TN 1691, 1948.

46. Lewis, J. P., "De-Icing Effectiveness of External Electric Heaters for Propeller Blades," NACA TN 1520, 1948.

47. Loughlin, Lt. W. J., "Propeller Electrical Anti-Icing Systems," AAF, Air Technical Service Command, Memo Rept. Serial TSELA-3C-581-144-6, September 1944.

48. Mambretti, F. J., "Instructions for Installations of Thermal Electric Propeller Anti-Icing Equipment on Hamilton Standard 23E50 Propellers," September 1943.

49. Miller, T. L., Korkan, K. D., and Shaw, R. J., "Analytical Determination of Propeller Performance Degradation Due to Ice Accretion," AIAA 85-0339, January 1985.

50. Miller, Thomas L., "Analytical Determination of Propeller Performance Degradation Due to Ice Accretion," NASA CR-175092, Prepared for Lewis Research Center Under Contract NAS 3-24105, April 1986.

51. Mitenzwei, E., "The Development of an Internal Electrical De-Icing System, with Addendum I," Curtiss-Wright Corp., Propeller Div., Rept. No. C-2184, June 1951.

52. Milholland, D. R. and Perkins, P. J., "Investigation of Effectiveness of Air-Heating a Hollow Steel Propeller for Protection Against Icing. I - Unpartitioned Blades," NACA TN 1586, 1948.

53. Mulholland, D. R. and Perkins, P. J., "Investigation of Effectiveness of Air-Heating a Hollow Steel Propeller for Protection Against Icing. III - 25-Percent Partitioned Blades," NACA TN 1588, 1948.

54. Neel, Jr., C. B. and Bright, L. G., "The Effect of Ice Formations on Propeller Performance," NACA TN 2212, 1950.

55. Neel, Jr., C. B., "An Investigation Utilizing an Electrical Analogue of Cyclic De-Icing of Hollow Steel Propellers with Internal Electric Heaters," NACA TN 3025, 1953.

56. Neel, Jr., C. B., "An Investigation Utilizing an Electrical Analogue of Cyclic De-Icing of a Hollow Steel Propeller with an External Blade Shoe," NACA TN 2852, 1952.

57. Neel, Jr., C. B., "An Investigation of the Characteristics of a Propeller Alcohol Feed Ring," NACA RB 4F06 (WR A-50), June 1944.

58. Orr, J. L., "Interim Report on Flight Tests on Thermal Electric Propeller De-Icing," NRC Report MD-25, November 1942.

59. Orr, J. L., "Full Scale Ground Icing Trials of Thermal-Electric Propeller De-Icing," Nat. Res. Council, Canada, Rept. No. MD-20, October 1942.

60. Orr, J. R,, "The Development of Electro-Thermal Propeller De-Icing," NRCDME/NAE Quarterly Bulletin Article, 1947(4), October-December 1947.

61. Perkins, P. J. and Millenson, M. B., "An Electric Thrust Meter Suitable for Flight Investigation of Propellers," NACA RM E9C17, 1949.

62. Perkins, P. J. and Mulholland, D. R., "Investigation of Effectiveness of Air-Heating a Hollow Steel Propeller for Protection Against Icing. II - 50-Percent Partitioned Blades," NACA TN 1587, 1948.

63. Petrovskii, V. S., "Nonsteady-State Heating of a Solid Nonmetallic Propeller Blade for Ice Removal," Inzhenerno-Fizicheskii Zhurnal, Vol. 8, pp. 593-596, May 1965. (In Russian).

64. Petrovzkii, V. S., "Unsteady Heating in De-Icing of a Nonmetallic Propeller Blade," (Translation) Journal of Engineering Physics, Vol. 8, pp. 02-404, May 1965.

65. Reaser, W. W., "Flight Tests of Hamilton Electrically Heated Propeller on DC-6 No. NX-37501," SM-12091, March 1947.

66. Rodert, L. A., "The Effects of Aerodynamic Heating on Ice Formations on Airplane Propellers," NACA TN 799, 1941.

67. Rodert, L. A., "A Flight Investigation of the Distribution of Ice-Inhibiting Fluids on a Propeller Blade," NACA TN 727, September 1939.

68. Schaefer, V. J., "The Use of High Speed Model Propellers for Studying De-Icing Coatings at Mt. Washington Observatory," Basic Icing Research by General Electric Co., Fiscal Year 1946, U. S. Air Forces, Tech. Rept. 5539, 1947.

69. Scherrer, R. and Rodert, L. A., "Tests of Thermal-Electric De-Icing Equipment for Propellers," NACA ARR 4A20 (WR A-47), January 1944.

70. Scrase, N., "An Investigation Into the Manner of Propeller Ice Formation and Shedding and Its Consequences for Propulsive Efficiency," Dowty Rotor Limited, England.

71. Selna, J.and Darsow, J. F., "A Flight Investigation of the Thermal Performance of an Air-Heated Propeller," NACA TN 1178, 1947.

72. Sheets, J. H. and Sand, E. J., "Development and Application of Electric Heating to De-Icing of Aircraft Propellers," Curtiss-Wright Corp., September 1947.

73. Tribus, M., "Intermittent Heating for Aircraft Ice Protection with Application to Propellers and Jet Engines," Aircraft Gas Turbine Division, Gen. Elec. Co. (Lynn, Mass.), Sept. 1949, SAME, Trans., Vol. 73, 1951.

CHAPTER VIII

SECTION 6.0

INDUCTION SYSTEM ICING

BIBLIOGRAPHY

VIII.6.0 INDUCTION SYSTEM ICING

1. "Carburetor Ice in General Aviation," NTSB-AAS-72-1, PB 208 463, Jan.19,1972.

2. "Report on Icing Tests of Intake Ducts," German Report No.F-TS-2641-RE,September 1947.

3. Rroeshe, Capt. R. W. and Johnson, S/Sgt. R. P., "Flight Icing Tests ofF-94 Air Induction System," WADC TN 52-75, October 1952.

4. Cavage, W., et al, "Light Aircraft Piston Engine Carburetor Ice Detector/Warning Device Sensitivitv/Effectiveness," DOT/FAA/CT-82/44, AD-A117- 745, June 1, 1982.

5. Chapman, G. E. and Zlotowski, E. D., "Laboratory Investigation of Icing in Carburetor and Supercharger Inlet Elbow of the Lockheed P-38J Airplane.IV-Effect of Throttle Designs and Method of Throttle Operation on Induction - System Icing Characteristics," NACA MR E5L27 (WR E-173), January 1946.

6. Chapman, G. E., "A Preliminary Investigation of the Icing Characteristics of the Chandler-Evans 58 CPB-4 Carburetor," NACA MR D6G11 (WR E-284), July 1946.

7. Coles, W. D., "Laboratory Investigation of Ice Formation and Elimination in the Induction System of a Large twin-Engine Cargo Aircraft," NACA TN 1427, September 1947.

8. Coles, W. D., "Investigation of Icing Characteristics of a Typical Light-Airplane Engine Induction System," NACA TN 1790, 1949.

9. Coles, W. D., Rollin, V. G., and Mulholland, D. R., "Icing Protection Requirements for Reciprocating-Engine Induction Systems," NACA TN 1982, 1950.(Also NACA TN 1993, 1949.)

10. Duffy, R. J. and Shattuck, B. F., "Integral Engine Inlet Particle Separator, Volume II - Design Guide," Report Number USAAMRDL-TR-75-31B, August 1975.

11. Essex, H. A. and Galvin, H. B., "A Laboratory Investigation of Icing and Heated-Air De-Icing of a Chandler-Evans 1900 CPB-3 Carburetor Mounted on a Pratt and Whitney R-1830-C4, Intermediate Rear Engine Section," NACA ARR E4J03 (WR E-15), October 1944.

12. Essex, H. A., Keight, W. C., and Mulholland, D. R., "Laboratory Investigation of Icing in the Carburetor and Supercharger Inlet Elbow of the Lockheed P-38J Airplane II - Determination of Limiting-Icing Conditions," NACA MR E5L18a (WR E-171), December 1945.

13. Essex, H. A., Zlotowski, E., and Ellisman, C., "Investigation of Ice Formation in the Induction System of a Lockheed P-38J Airplane.I - Ground Tests," NACA MR E6B28 (WR E-176), March 1946.

14. Gardner, L. and Moon, G., "Aircraft Carburetor Icing Studies," NRC ReportLR-536, July 1970.

15. Gardner, L., "Aircraft Carburetor Icing," NRC DME Newsletter, Standards Series, Vol. 2, No. 1, April 1973.

16. Gardner, L., Moon, G., and White, R. B., "Aircraft Carburetor Icing Studies," SAE Paper 710371, 1971.

17. House, R. L. and Potash, M. L., "CH-53A Engine Air Inlet Anti-Icing Test Report," AD-483-125, January 1966.

18. Kimball, L. B., "Icing Tests of Aircraft-Engine Induction Systems," NACAARR (WR W-97), January 1943.

19. Lewis, J. P., "Investigation of Aerodynamic and Icing Characteristics of a Flush Alternate-Inlet Induction-System Air Scoop," NACA RM E53E07, 1953.

20. Lewis, J. P., "Wind Tunnel Investigation of Icing of an Engine Cooling-Fan Installation," NACA TN-1246, Jan. 1, 1947.

21. Lyons, R. E. and Coles, W. D., "Laboratory Investigation of Icing in the Carburetor and Supercharger Inlet Elbow of the Lockheed P-38J Airplane.III - Heated Air as a Means of De-Icing the Carburetor and Inlet Elbow," NACA MR E5L19 (WR E-172), December 1945.

22. Mulholland, D. R. and Chapman, G. E., "Laboratory Investigation of Icing in the Carburetor and Supercharger Inlet Elbow ot the Lockheed P-38J Airplane.VI - Effect of Modifications to Fuel-Spray Nozzle on Icing Characteristics," NACA MR E6A23 (WRE-175), January 1946.

23. Newman, R. L., "Flight Tests Results of the Use of Ethylene Glycol Mono- methyl Ether (EGME) as an Anti-Carburetor Icing Fuel Additive," TR-79-9, FAA-AWS-79-1, July 1979.

24. Newman, R, L., "Carburetor Ice Flight Testing: Use of an Anti-Icing Fuel Additive," J. of Aircraft, Vol. 18, No. 1, pp. 5-6, January 1981.

25. Obermayer, R. W., "A Study of Carburetor/Induction System Icing in General Aviation Accidents," NAS-CR-143835, N75-19208/8, March 1, 1975.

26. Renner, C. E., "Laboratory Investigation of Icing in the Carburetor and Supercharger Inlet Elbow of the Lockheed P-38J Airplane.V-Effect of Injection of Water-Fuel Mixture and Water-Ethanol-Fuel Mixtures on the Icing Characteristics," NACA MR E5L28 (WR E-174), December 1945.

27. Sawrence, W. C., "A Study of Carburetor Air Preheat," American Airlines,Revised August 1943.

28. Sparrow, S. W., "Airplane Crashes: Engine Troubles.A Possible Explanation," NACA TN 55, March 1921.

29. Speranza, F., "Nuclei of Condensation and Supersaturation - Relative Specific Humidity and Deposits of Ice on Airplane Carburetors," (Translation) Rivista Di Meteorologia Aeronautica, 4(2), pp.38-47, 1940.

30. SSex, H. A., "De-Icing of an Aircraft Engine Induction System," NACA ARR,3H13, WR W-45, August 1943.

31. Von Glahn, U. H. and Renner, C. E., "Development of a Projected Air Scoop for the Reduction of Induction-System Icing," NACA TN 1134, September 1946.

CHAPTER VIII

SECTION 7.0

TURBINE ENGINE AND INLET ICING

BIBLIOGRAPHY

VIII.7.0 TURBINE ENGINE AND INLET ICING

1. "Combating Ice in Gas Turbines," Flight, Vol.59, pp.414-415, April 1951.

2. "De-Icing Tests - A Major Step Towards SPEY Certification," The Aeroplane and Commercial Aviation News, Vol. 105, April 18, 1963.

3. "Engine Icing," Flying Safety, Vol. 9, pp. 16-19, December 1953.

4. "Engine Icing," Flying Safety, Vol. 10, p. 13, December 1954.

5. "F-89 Heat Anti-Icing Performance: Cowl Lip Entrance," Northrop Rept. No.A-68-III.

6. "Gas Turbine Icing Tests Under Project Summit," Naval Air Materiel Command, Aero.Engr.Lab, Experiment Station, Restricted Preliminary Rept.No. 2, Project TED No.NAM-PP3216, August 1950.

7. "Icing Evaluation of the T58-GE-10 Engine, H-3 Engine Inlet Ducts and T58 Water Wash Manifold," AD-476-442L.

8. "Icing in Jets," Canadian Aviation, 21(1), January 1948.

9. "Icing Testing for Aircraft Engines," Advisory Group for Aerospace Research and Development, AGARD-CP-236, AD-A059-452/3SL, August 1978.

10. "Investigation of Ultrasonics as an Anti-Icing Means for Turbojet Engines," Aero projects, Inc., Res.Rept.No.52-7, March 1952.

11. "Power Plant Protection Against Icing Conditions," British Civil Air-worthiness Requirements - BOAC.

12. "Proceedings of the Third Annual Conference on Environmental Effects on Aircraft and Propulsion Systems, September 19-20, 1963," AD-432-801L, September 1963.

13. "Proposals for Requirements Related to the Operation of Turbine Engines in Ice Forming Conditions," British Civil Airworthiness Requirements - BOAC.

14. "Thermal Anti-Icing Shields. F-89," Aviation Week, Vol. 59, p. 29, August 1953.

15. "Turbo-Jet Engine Icing," Technical Note No.5-55, Dept.of the Navy,August 4, 1955.

16. "Turbo-Prop Engine Air Inlet Duct Anti-Icing Tests XP5Y-1 Airplane," Project Summit, Consolidated Vultee, Rept.No.ZJ-117-009, June 1950.

17. Acker, L. W. and Kleinknecht, K. S., "Effects of Inlet Icing on Performance of Axial-Flow Turbojet Engine in Natural-Icing Conditions," NACA RM D50C15, May 1950.

18. Acker, L. W., "Preliminary Results of Natural Icing of An Axial-Flow Turbojet Engine," NACA RM E8C18, 1948.

19. Acker, L. W., "Natural Icing of an Axial-Flow Turbojet Engine in Flight for a Single Icing Condition," NACA RM E8F01a, 1948.

20. Ball, R. G. J. and Prince, A. G., "Icing Tests on Turbojet and Turbofan Engines Using the NGTE Engine Test Facility," AGARD Conf. Proc. No. 236, Ice Test for Aircraft Engines, Pape II, August 1978.

21. Bartlett, C. Scott, "An Analytical Study of Icing Similitude for Aircraft Engine Icing," DOT/FAA/CT-86/35, AEDC-TR-86-26, October 1986.

22. Bartlett, P. M. and Dickey, T. A., "Gas Turbine Icing Tests at Mt. Washington," SAE Paper presented in Los Angeles, 1950.

23. Bartlett, P. M. and Dickey, T. A., "Turbine-Engine Anti-Icing Tested Atop Mt.Washington," SAE, Journal, Vol.59, pp.25-28, January 1951.

24. Bender, D., "Tests under Snow and Icing Conditions with the BD 105 Engine Installation," AGARD Conference Proc.No.236, Ice Test for Airc.Engines, Paper 10, April 3-4, 1978.

25. Berg, A. L. and Wolf, H. E., "Aircraft Engine Icing Test Techniques and Capabilities at the AEDC," McDonnell Douglas Corporation, January 26, 1976.

26. Bowden, D. T., "Criteria for Design of Commercial Transport Turbine Engine Ice Protection Systems," Report No. TG-6l, Convair, June 27, 1956.

27. Brun, R. J., "Cloud-Droplet Ingestion in Engine Inlets with Inlet Velocity Ratios of 1.0 and O.7," NACA Report 1317 (Supersedes NASA TN 3593), 1956.

28. Chappell, M. S. and Grabe, W., "Aircraft Engine Anti-Icing," NRC DME Newsletter, Vol 1, No. 4, March 1972.

29. Chappell, M. S. and Grabe, W., "Icing Problems on Stationary Gas Turbine Powerplants," llth National Conference on Environmental Effects on Aircraft and Propulsion Systems, Trenton, N.J., May 21-24, 1974.

30. Chappell, M.S., "Stationary Gas Turbine Icing Problems: The Icing Environment," NRC DME/NAE Quarterly Bulletin No.1972(4).

31. Deacon, W., "Protection of Aircraft Turbine Engines Against Ice Accretion," Nat.Gas Turbine Est., Great Britain, Rept.No.R30.

32. Delhaye, J., "Icing of Turbojet Engines," (Translation) Bull.del'A.I.A., No. 1, 1957.

33. Dtriebel, E. E., "Ice Protection for Turbine Engines," Pratt and Whitney Aircraft, Paper prepared for the FAA Symposium on Aircraft Ice Protection, April 28-30, 1969, Washington, D. C.

34. Duffy, R. J. and Shattuck, B. F., "Integral Engine Inlet Particle Separator, Volume II - Design Guide," Report Number USAAMRDL-TR-75-31B, August 1975.

35. Gelder, T. F., "Total Pressure Distortion and Recovery of Supersonic Nose Inlet with Conical Centerbody in Subsonic Icing Conditions," NACA RM E57G09, 1957.

36. Gelder, T. F., "Droplet Impingement and Injestion by Supersonic Nose Inlet in Subsonic Tunnel Conditions," NACA TN 4268, Jan.1, 1958.

37. Gillingham, G. R., "A New System for Preventing Icing of Gas Turbine Inlets," Project Engineer, Donaldson Company, Inc.

38. Grabe, W. and Tedstone, D., "Icing Tests on a Small Gas Turbine with Inertial Separation Anti-Icing System," PEP 51st (A) Specialists' Meeting on Icing Testing for Aircraft Engines, AGARD Conference Proceedings No.236, 1978.

39. Grabe, W. and Vanslyke, G. K., "Icing Tests on the JT15D Turbofan Engine," Proceedings of the Tenth National Conference on Environmental Effects on Aircraft and Propulsion Systems, Sponsored by Naval Air Propulsion Test Center, 18-20 May 1971.

40. Gray, V. H. and Bowden, D. T., "Icing Characteristics and Anti-Icing Heat Requirements for Hollow and Internally Modified Gas-Heated Inlet Guide Vanes," NACA RM E50I08, 1950.

41. Hawthrone, R., "Jet Engine Icing Protection Systems," Aviation Operation,Vol. 14, pp. 24-25, July 1950.

42. Hayward, L. H., "De-Icing of Gas-Turbine Engines," Aeroplane, Vol. 82,pp. 243-246, February 29, 1952.

43. Heinrich, A., Ross, R, and Ganesan, N., "Engine Inlet Anti-Icing System Evaluation Procedures," FAA-RD-80-50, Federal Aviation Administration, January 1980.

44. Hensley, R. V., Rom, F. E., and Koutz, S. L., "Effect of Heat and Power Extraction on Turbojet-Engine Performance.1 - Analytical Method of Performance Evaluation with Compressor-Outlet Air Bleed," NACA TN 2053, 1950.

45. Hunt, J. D., "Engine Icing Measurement Capabilities at the AEDC," AGARD Conf. Proc. No. 236, Ice Test for Aircr.Engines, Paper 4, August 1978.

46. Jones, C. and Palmieri, J., "Falcon 10 Engine Anti-Icing System Performance Analysis," McDonnell Douglas Corporation, April 12, 1971.

47. Kim, J. J., "Computational Particle Trajectory Analysis on a Three-Dimensional Engine Inlet," AIAA Paper 85-0411, 1985.

48. Kim, J. J., "Particle Trajectory Computation of a 3-Dimensional Engine Inlet," NASA CR-175023, DOT-FAA-CT-86-1, Prepared for Lewis Research Center Under Grant NAG 3-566, January 1986.

49. Lacey, Jr., J. J., "Turbine Engine Icing and Ice Detection," ASME Paper 72-GT-6 for Meeting March 26-30, 1972.

50. Morrell, S. F. and Frischnertz, N. F., "Ice-Proofing the J-47 Turbojet,"SAE Journal, Vol. 59, pp. 43-47, February 1951.

51. Nelepovitz, D. O. and Rosenthal, H. A., "Electro-Impulse De-Icing of Aircraft Engine Inlets," AIAA-86-0546, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

52. O'Neil, J. E. and Zdrazil, J. A., "Investigation of Methods of Anti-Icing Gas Turbine Inlet Components," Wright Air Development Center, Power Plant Laboratory, WADC Technical Report 56-292, June 1956.

53. Pfeifer, G. D. and Maier, G. P., "Engineering Summary of Powerplant Icing Technical Data," Department of Transportation, Federal Aviation Administration, RD-77-76, July 1977.

54. Pfeifer, G. D., "Aircraft Engine Icing Technical Summary," AGARD Conf. Proc. No. 236, Ice Test for Aircraft Engines, Paper 9, August 1978.

55. Prior, B., "Grumman Gulfstream II Cowl Anti-Icing System Performance Analysis and Comparison with Flight Test Data for Dry Air Conditioning," January 1968.

56. Quan, D and Rush, C. K., "Aircraft Gas Turbine Ice Prevention - The Design and Development of Hot Air Surface Heated Systems," The Canadian Aeronautical Journal, Vol. 3, pp. 318-324, 1957.

57. Quist, S. M., "Engine Inlet Screen Icing Test Report," REC 2715, Jan.1, 1971.

58. Rosen, K. M. and Roy, D. B., "Analytical Design of the H-3 Helicopter Engine Inlet Ice Deflector Shield," Bordentown, N. J., Proceedings of the 8th Annual National Conference on Environmental Effects on Aircraft and Propulsion Systems, October 8-10, 1968.

59. Rosenthal, H. A., "Wing Engine Nose Cowl Anti-Icing Design Analysis DC-10-10 Revised," Rohr Report, McDonnell Douglas Corporation.

60. Samaras, D. G. and Bachmeier, A. J., "The Use of Alcohol for Ice Prevention and Its Effect on the Performance of Axial Flow - Gas Turbines," NRC Report MT-3, April 1948.

61. Samaras, D. G. and Bachmeier, A. J., "Performance of an Axial FlowTurbo-Jet with Alcohol Deicing," NRC Report MT-7, May 1948.

62. Samolewicz, J. J. and MacCaulay, G. A., "First Interim Report on Icing Investigation of Turbo-Jet Engines," NRC Report ME-159, September 1947.

63. Samolewicz, J. J. and McCaulay, G. A., "Notes on some Charge Heating Anti-Icing Tests with an Axial Flow Turbojet," Nat. Res. Council, Canada, Rept. No. ME-173, December 1948.

64. Seielstad, H. D., and Sherlock, J. J., "The Powered Centrifugal Separator for Turbine Engine Inlet Protection," Environmental Effects on Aircraft and Propulsion Systems, Naval Air Propulsion Test Center, 9th Annual National Conference Proceedings, October 7-9, 1969.

65. Sherlaw, W., "Some Aspects of Engine Icing," Aircraft Icing Protection Conference, 1958.

66. Shires, G. L. and Munns, G. E., "The Icing of Compressor Blades and Their Protection by Surface Heating," ARC R&M No. 3041, 1955.

67. Stallabrass, J. R. and Price, R. D., "Icing and the Helicopter Powerplant," AGARD Conference Proceedings No.31, Helicopter Propulsion Systems, Paper 22, June 1968.

68. Stephenson, C. D., Shohet, H. N., and Rosen, K. M., "Design, Manufacture, and Testing of the CH-54A/B Engine Air Particle Separator Anti-Ice System," Proc. 10th Natl. Conf. on Environmental Effects on Aircraft and Propulsion Systems, May 18-20, 1971.

69. Striebel, E. E., "Ice Protection for Turbine Engines," FAA Report of Symposium on Aircraft Ice Protection, April 28-30, 1969, Washington, D.C.

70. Tedstone, D., "Technical Evaluation Report on the 51st (A) Specialists' Meeting of the Propulsion and Energetics Panel on Icing Testing for Aircraft Engines," AGARD-AR-124, AD-A060-294/SL, August 1978.

71. Teslenko, A. I., "Icing of Aircraft Gas Turbine Engines," (Translation) Voyenizdat, 1961.

72. Teslenko, A. I., "Aircraft-Icing Hazards," (Translation) Icing of Air-craft Gas-Turbine Engines Moscow, Voyenizdat, 1961.

73. Tribus, M., "Intermittent Heating for Aircraft Ice Protection with Application to Propellers and Jet Engines," Aircraft Gas Turbine Div., Gen.Elec. Co. (Lynn, Mass.), September 1949.

74. Tribus, M., "Intermittent Heating for Aircraft Protection with Application to Propellers and Jet Engines," Aircraft Gas Turbine Division, Gen.Elec. Co. (Lynn, Mass.), Sept. 1949, SAME, Trans. Vol. 73, 1951.

75. Von Glahn, U. H. and Blatz, R. E., "Investigation of Aerodynamic and Icing Characteristics of Water-Inertia-Separation Inlets for Turbojet - Engine Ice Protection," NACA RM E50E03, 1950.

76. Von Glahn, U. H., and Blatz, R. E., "Investigation of Power Requirements for Ice Prevention and Cyclical De-Icing of Inlet Guide Vanes with Internal Electric Heaters," NACA RM E50H29, 1950.

77. Von Glahn, U. H., Callaghan, E. E., and Gray, V. H., "NACA Investigations of Icing-Protection Systems for Turbojet-Engine Installation," NACA RM E51B12, 1951.

78. Wilcox, K. H., "Environmental Testing of the Improved Engine and Windshield Anti-Ice and Rotor Blade Deice Systems Installed in the CH-46A Helicopter," Naval Air Test Center, Patuxent River, Md., NATC-ST-18R-66, March 7, 1966,

79. Willbanks, C.E. and Schulz, R. J., "Analytical Study of Icing Simulation for Turbine Engines in Altitude Test Cells," AEDC-TR-73-144 (AD-770-069), November 1973.

80. Zumwalt, G. W., "Icing Tunnel Tests of Electro-Impulse De-Icing of an Engine Inlet and High Speed Wing," AIAA Paper 85-0466, 1985.

CHAPTER VIII

SECTION 8.0

WING ICING

BIBLIOGRAPHY

VIII.8.O WING ICING

1. "Ice Formation on Wings and Other Structural Parts of Aircraft," (Preliminary Report.) NACA MP 20, March 1928.

2. "Wing Icing Conditions Throughout the World," U.S.Air Weather Service Rept. No. 270, September 1943.

3. Bowden, D. T., Gensemer, A. E., and Skeen, C. A., "Engineering Summary of Airframe Icing Technical Data," FAA Technical Report ADS-4, 1964, AD-6O8- 865.

4. Bragg, M. B. and Gregorek, G. M., "An Analytical Evaluation of the Icing Properties of Several Low and Medium Speed Airfoils," AIAA Paper 83-0109, 1983.

5. Bragg, M. B. and Gregorek, G. M., "An Analytical Approach to Airfoil Icing," Paper No.AIAA-81-0403, AIAA 19th Aerospace Sciences Meeting, st.Louis, Mo., January 12-15, 1981.

6. Bragg, M. B., "The Effect of Geometry on Airfoil Icing Characteristics,"AIAA Journal of Aircraft, Vol. 21, No. 7, July 1984, pp. 505-511.

7. Bragg, M. B., Gregorek, G. M., and Lee, J. D., "Experimental and Analytical Investigations Into Airfoil Icing," 14th Congress of the Aeronautical Sciences, Toulouse, France, September 10-14, 1984.

8. Ljungstroem, B., "Wind Tunnel Investigations of Simulated Hoar Frost on a 2-Dimensional Wing Section With and Without High Lift Devices," FAA, AU-9902, Aeronautical Research Institute of Sweden, 1972.

9. McKnight, R. C., Palko, R. L., and Humes, R. L., "In-Flight Photogrammetric Measurement of Wing Ice Accretions," AAIA-86-0483, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

10. Mkhitaryan, A. M., Kas'yanov, V. A., Golyakov, L. P., and Koval, Yu.G., "On the Modes of Icing of Symmetrical Lifting Surfaces," Fluid Mech.,Sov.Res., Vol. 2, No. 6, pp. 151-156, November-December 1973.

11. Olsen, W., Walker, E., and Sotos, E., "Close-Up Movies of the Icing Process on the Leading Edge of an Airfoil," NASA Lewis Research Center Movie C-313, 1985.

12. Ritz, L., "Ice Formation on Wings," NACA TM 888, February 1939.

13. Ross, R., "Thermodynamic Performance of an Airplane Wing Leading Edge Anti-Icing System," Journal of Aircraft, 1983, Vol. 21, No. 7, pp.536-537.

14. Shaw, R.J., Sotos, R.G., and Solano, F.R., "An Experimental Study of Airfoil Icing Characteristics," AIAA 82-0282, January 1982.

15. Shaw, R. J., Sotos, R. G., and Solano, F. R., "An Experimental Study of Airfoil Icing Characteristics," NASA TN 82790, January 1982.

CHAPTER VIII

SECTION 9.0

WINDSHIELD ICING

BIBLIOGRAPHY

VIII.9.0 WINDSHIELD ICING

1. "Tin-Plated Glass to Fight Windshield Ice," Aviation Week, Vol. 56, May 1952.

2. "Transparent Areas on Aircraft Surfaces, Rain Removing and Washing Systems for Defrosting, De-Icing, Defogging," MIL-T-5842B (AS), March 29, 1985.

3. "Spray Equipment, Aircraft Windshield, Anti-Icing," MIL-S-6625 (ASG),March 1953.

4. "Determination of Air Flow Requirements for Window Defrosting," Report No.D-5528, Boeing Aircraft Company, September 6, 1945.

5. "Model B-57B Windshield Nozzle Anti-Icing Performance Tests, Summit Mt.Washington," Engineering Report No.5580 (Confidential), Glenn L.Martin Company, June 23, 1953.

6. "Research and Development of Laminated Glass Aircraft Windshields," Report No. 27, Project No. 90-692-D-ATI-152809, Armour Research Foundation of Illinois Institute of Technology.

7. "Set of Progress Reports on Windshield Jet Air Blast Rain Removal,"Research Inc., Hopkins, Minnesota.

8. "Jet Blasts Windshield Rain Removal Systems for Aircraft," SAE Aerospace Information Report.

9. "Evaluation of the 'Sierracote' Electrically Heated Windshield in anL-23D," ATBG-DT-AVN-3458, AD-A029-759, March 27, 1959.

10. Breeze, R. K. and Paselk, R. A., "Preliminary Summary of the B-1 Jet Blast/Simulated Acrylic Windshield Test Results and Flight Safety Verification," B-1 Division, Report TFD-74-715, Rockwell International, August 1974.

11. Burke, F. J., "Evaluation of a Jet Bleed Windshield Rain Removal System and Rain Removal System and Repellant," Technical Note WADC-55-117, Directorate of Flight and All-Weather Testing, July 1955.

12. Collingwood, D. G., "Electrically-Heated Transparencies," Aircraft Engineering, No. 4, 1963.

13. Dahm, T. M. and Webster, D. A., "De-Icing Tests of NASA Double Glass Windshield and Appendix A-Model F94-C," ASTIA AD-5-126, Lockheed Aircraft Corp., Rept.No.8392, January 1952.

14. Dekalenkov, S. S., "Electrically Heated Glass on Civilian Aircraft,"(Translation) Redizdat, Aeroflot, 1957.

15. Dunham, J. A., "Tests of Rain Removal on the Windshield and Side Panels Using Boundary-Layer Anti-Icing System Air Discharge Nozzles," Applicable to F-100A Airplanes, N.A.A. Model NA-180 Fighter, NA-52-663, July 30, 1952.

16. Dunham, J. A., "Development Test of Windshield Armor Glass-Anti-Icing Nozzle to Prevent Glass Cracking Due to Thermal Shock," Class - Fighter Applicable to F-86E Airplanes N.A.A., Model NA-172, NA-52-918, September 11, 1952.

17. Followill, R. J., "Report of Test - Comparative Evaluation of Two Types of Electrically Heated Windshields Installed on a CV-2A Airplane," AD-A031-900/4, Sept.30, 1963.

18. Foster, R. C., "Windshield Anti-Icing Analysis Report for the A-7D/E Aircraft," Vought Report 2-53910/9R-8239, February 1969.

19. Griffith II, W. E., Mittag, C. F., Hanks, M. L., and Hawley, M. A., "Artificial Icing Tests UH-1H Helicopter.Part II.Heated Glass Windshield," USAASTA-73-04-4, January 1974.

20. Hasinger, S. H. and Larson L. V., "Infra-Red Heating for Anti-Icing, De-Icing, and Defrosting of Aircraft Transparent Areas," USAF-AF Technical Report No.6113, March 1950.

21. Hassard, Richard S., "Plastics for Aerospace Vehicles, Part II, Transparent Glazing Materials," MIL-HDBK-17A, Part II, January 1973.

22. Hauger, Jr., H. H., "A Graphical Solution of Windshield Heat Producing Problems," Douglas Aircraft Co., June 1944.

23. Islinger, J. S., "Engineering Design Factors for Laminated Aircraft Windshields," WADC TR 53-99, ASTIA AD-51601, April 1954.

24. Jakob, M. S., Kezios, C., Sinila, A., Sogin, H. H., and Speilman, M., "Aircraft Windshield Heat and Mass Transfer," Illinois Inst.of Technology, AF TR 6120, Part 5, June 1952.

25. Jones, A. R. and Spies, Jr., R. J., "An Investigation of a Thermal Ice-Prevention System for a C-46 Cargo Airplane.III - Description of Thermal Ice-Prevention Equipment for Wings, Empenage and Windshield," NACA ARR No. 5AO3b, 1945.

26. Jones, A. R., Holdaway, G. H., and Steimnetz, C. P., "A Method for Calculating the Heat Required for Windshield Thermal Ice Prevention Based on Extensive Flight Tests in Natural-Icing Conditions," NACA TN No.1434, 1947.

27. Kleinknecht, K. S., "Flight Investigation of the Heat Requirements for Ice Prevention on Aircraft Windshields," NACA RM E7G28, September 1947.

28. Kushnick, J. L., "Thermodynamic Design of Double-Panel, Air-Heated Windshields for Ice Prevention," NACA RB No. 3F24, 1943.

29. Lawrence, James H., "Guidelines for the Design of Aircraft Windshield/ Canopy Systems," AFWAL-TR-80-3003, Final Report for the Period June 1978-December 1979, Air Force Wright Aeronautical Laboratories, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio 45433, February 1980.

30. Letton, G. C., "An Analytical Investigation of Aircraft Windshield Anti-Icing Systems," Master's Thesis, Ohio State University, 1972.

31. Letton, G. C., "An Analytical Investigation of Aircraft Windshield Anti-Icing Systems," AFML-TR-73-126, Conference on Transparent Aircraft Enclosures, June 1973.

32. Meline, H. R. and Smith, I. D., "Design Manual of Windshield Jet Air Blast Rain and Ice Removal," WADC TR 58-444, ASTIA AD-208-282, November 1958.

33. Miller, P. A., "Anti-Icing Aspects of Helicopter Windshield Design,"International Helicopter Icing Conference, May 1972

34. Milsum, J. H., "Electrically Heated Aircraft Windscreens," NRC RepotLR-43, December 18, 1952.

35. Olson, J. B. and Stefancin, T. R., "Optimization of the Electrically Anti-Iced Helicopter Windshield," Rotary Wing Icing Symposium, June 1974.

36. Paynter, H. L., "Windshield Rain Clearing and Anti-Icing Systems for the TF-102A Model 8-12 Airplane," Convair Report 2J-8-022, ASTIA AD-20925, August 1955.

37. Paynter, H. L., "Windshield Rain-Clearing and Anti-Icing System for the F-IO2A, Model 8-10 Airplane," Convair Report 2J-8-021 (Addendum 1), ASTIA AD-20922, June 1956.

38. Qureshi, J., Screen, T. R., and Sharpe, W. F., "Windshield Anti-Icing Analytical Studies F-5A/B (G)," Northrop Report NOR 65-11, April 1965.

39. Rea, S. N. and Wriston, R. S., "Development of Deicing Methods for Chalcogenide Windows for Reconnaissance and Weapon Delivery," AFAL-TR-73-340, October 1973.

40. Rodert, L. A., "An Investigation of the Prevention of Ice on the Airplane Windshield," NACA TN 754, March 1940.

41. Ross, R., "Analysis of an Airplane Windshield Anti-Icing System Using Hot Air," Journal of Aircraft, Vol. 20, No. 11, November 1983.

42. Rothe, F., "AIRCON Electrically Heated Acrylic," SAE Prepr. No. 790600f or Meet, April 3-6, 1979.

43. Rudolph, J. D., "Windshield Anti-Icing System Tests and Icing Investigation of Additional Components F-86D Airplane," NAA Model NA-165, NA-51-961, ASTIA AD-36003, 1950-51 Icing Season, Project Summit - Mt.Washington, May 10, 1952.

44. Ruggeri, R. S., "Preliminary Data on Rain Deflection from Aircraft Windshields by Means of High-Velocity Jet-Air Blast," NACA RM E55E17a, 1955.

45. Scherrer, R. and Young, C. G., "An Investigation of the Characteristics of Alcohol-Distribution Tubes Used for Ice Protection on Aircraft Windshields," NACA ARR 4826 (WR A-20), February 1944.

46. Selna, J. and Zerbe, J. E., "A Method for Calculating the Heat Required for the Prevention of Fog Formations on the Inside Surfaces of Single Panel Bullet-Resisting Windshields During Diving Flight," NACA TN 1301, July 1947.

47. Strouse, Edward A., "Development of De-Icing Techniques for Dielectric Windows," AFML-TR-75-99, AD-A017-097/7, Aug.1, 1975.

48. Waine, A. C., "Windscreen De-Icing," Aeronautics, Vol.22, May 1950.

49. Ward, J. W., "Aircraft Windshields Heated by Means of Transparent Conductive Films," AIEE.

50. Weiner, F. R., Oberto, J., and Paselk, R.A., "B-1 Air Vehicle-An Analysis of External Surface Heat Requirements for Windshield Anti-Icing," North American Rockwell Report NA-72-1056, December 1972.

51. Wilcox, K. H., "Environmental Testing of the Improved Engine and Windshield Anti-Ice and Rotor Blade Deice Systems Installed in the CH-46A Helicopter," Naval Air Test Center, Patuxent River, Md., NATC-ST-18R-66, March 7, 1966.

52. Wiser, G. J., "Design and Operational Experience with Electrically Heated Windshields and Canopies," Aircraft Ice Protection Conference, June 1959.

CHAPTER VIII

SECTION 10.0

RADOME ICING

BIBLIOGRAPHY

VIII.10.0 RADOME ICING

1. "Radome Engineering Manual," Published by Direction of the Chief of the Bureau of Aeronautics, October 1948.

2. Ackley, S. F., Itagaki, K., Frank, M. D., "De-Icing of Radomes and Lock Walls Using Pneumatic Devices," Journal of Glaciology, 1977, Vol. 19, No.81, pp.467-478.

3. Amerman, A. E., "Test Installation and Icing-Flight Tests of a Heated-Model Radome," WADC TN 55-60, April 1955.

4. Bowden, D. T. and Milton, H. W., "Effect of Ice and Glycol on C-5A Scale Model Radome Transmission Efficiency," LGITC-1-17, Lockheed-Georgia, April 1966.

5. Fyall, A. A., "Dielectric Measurements on Various Radome Materials and the Effect of Moisture Absorption and Temperature," Technical Note No.Chem.1209, McDonnell Douglas Corp.

6. Lake, H. G., "An Investigation of the Problem of Ice Removal from B-29 Radomes," WADC-TR-52-46, AD-A075-858/0, January 1952.

7. Lenherr, F. E. and Young, R. W., "Development of Spray System Radome Anti-Icing-Final Report," Report No. TDM-68-III, Northrop Aircraft, Inc., January 1953.

8. Lenherr, F. E., "A Method of Ice Protection for Radomes," SAE Preprint No. 811B, SAE, National Aeronautical Meeting, 1952.

9. Lewis, J. P. and Blade, R. J., "Experimental Investigation of Radome Icing and Icing Protection," NACA RM E52J31, 1953.

10. Lewis, J. P., "An Analytical Study of Heat Requirements for Icing Protection of Radomes," NACA RM E53A22, March 1953.

11. Ray, C. L., "Anti-Icing of AN/APS-42 Nose Radome for C-130A Airplane,"Lockheed ER-1324, August 1955.

12. Sandoval, R. G., "Design of the Radome Anti-Icing System for the C-133A Aircraft," Douglas LB-21842, March 1955.

13. Sowa, W., "Radome Design Development Report Anti-Icing, C-130 Airplane Section I - Thermal Design," Goodyear GER-7067, December 1955.

14. Stone, J., et al, "Gates Learjet Model 55 Radome Icing Analysis," RAA 80-5, Dec.1, 1980.

15. Torgeson, W. L. and Abramson, A. E., "A Study of Heat Requirements for Anti-Icing Radome Shapes with Dry and Wet Surfaces," WADC TR 53-284, AD- 25909, September 1953.

CHAPTER VIII

SECTION 11.0

HELICOPTER ICING AND CLIMATIC TESTS

BIBLIOGRAPHY

VIII.11.0 HELICOPTER ICING AND CLIMATIC TESTS

1. "Aerospatiale's Experience on Helicopter Flight in Icing Conditions,"SNIAS-832-210-107, N84-25707, April 3, 1984.

2. "Arctic Service Test of OH-58A Helicopter/XM27E1 Armament Subsystem,"AD-875-563L.

3. "Article Environmental Test of Rotary Wing Aircraft," AD-867-368.

4. "Chinook's Trial by Ice," Flight International, Aprii 28, 1984.

5. "Climatic Laboratory Check Test of the CH-47A Helicopter," Army Aviation Test Board, AD-410-743L.

6. "Climatic Laboratory Test of the YHC-1B (CH-47A) Helicopter," Army Aviation School, Fort Rucker, AVN 162 CL, AD-294-9291, December 1962.

7. "Climatic Laboratory Test of the YHU-1D Helicopter," Army Aviation School, AVN 1562, AD-294-337L, December 1962.

8. "Fiberglass Diffusers for CH-37B Helicopter Under Arctic Winter Conditions, Product Improvement Test.Final Letter Report," Army Test Board, AD-478-130, July 15, 1965.

9. "Further Natural Icing/Snow Trials of a Wessex Mk 3 Helicopter,"AD-511-958.

10. "HU-1 Heater Incorporating a Purge System, Army Arctic Test Center,AD-A234-240, February 1960.

11. "Icing and De-Icing Flight Tests of a Kaman HU2K-1 Helicopter," NRC Aero Report LR-308, May 1961.

12. "Icing Trials of the SH-3D Helicopter," AD-852-331L.

13. "Notes on Winter Arctic Operation of Helicopters," AD-849-184.

14. "Ottawa Spary Rig Tests of an Ice Protection System Applied to UH-1H Helicopter," Lockheed California Company, ISAANROL-TR-76-32, November 1976.

15. "Rotorcraft Icing - Progress and Prospects," AGARD Advisory Report No. 223, September 1986.

16. "Service Test of the CH-47A Helicopter Under Arctic Winter Conditions," Army Arctic Test Center, AD-451-633, Final Test Report.

17. "Service Test of the HU-1B Helicopter," Army Arctic Test Center, AD-277-268L, May 1962.

18. "Supplementary Icing Test of the CH-3C Helicopter," AD-834-179L.

19. Abbott, W. Y., et al, "Evaluation of UH-1H Hover Performance Degradation Caused by Rotor Icing," USAAEFA Project No.82-12, Final Report, 1983.

20. Adam, C. F., Bowers, and Abbott, "Artificial and Natural Icing Test of the VCH-47D," USASEFA-79-07, AD-A122-964, July 1, 1981.

VIII.11.0 HELICOPTER ICING AND CLIMATIC TESTS (CONTINUED)

21. Adams, R., "Helicopter Icing Research, Proceedings," Second Annual Workshop on Meteorological and Environmental Inputs to Aviation Systems, FAA-RD-78-99, NASA CP 2057, 1958.

22. Ashwood, P. F. and Brooking, R. L., "Tests of Helicopters in Simulated Icing Conditions," Royal Aeronautical Society Symposium, November 1975.

23. Ashwood, P. F. and Swift, R. D., "Icing Trials on the Front Fuselage and Engine Intakes of Helicopters at Conditions Simulating Forward Flight," AGARD Advisory Report No. 127, Paper 3, September 30, 1977.Published 1978.

24. Atkinson, F. S., "Investigation of Helicopter Icing Environment Report,"BEAH/ENG/TD/R/113, January/April 1971.

25. Barbagallo, J. L., "Climatic Laboratory Evaluation of the HH-53C Helicopter.Data Supplement," ASD-ASTDE-TR-70-29-SUPPL, AD-911-413/3SL, May 1973.

26. Bourdeaux, III, E. J., "Category II Adverse Weather Tests of the UH-1F Helicopter," ASD-TR-66-7, AD-486-740L, May 1966.

27. Brendel, J. and Balfe, P. J., "H-43B.Category II/III System and Operational Evaluation," AFFTC TR60-21, AD-249-824, October 1960.

28. Brigoglio, R. and Panaszewski, J., "Flight Evaluation of the H-34A RS-58 Helicopter Ice Control System," AD-234-676L.

29. Buckanin, R. M. and Tulloch, J. S., "Artificial Icing Test Utility Tactical Transport Aircraft System (UTTAS) Sikorsky YUH-60A Helicopter," USAAEFA-76-09-1, AD-A109-530/6, February 1977.

30. Bunn, F. C., "Cold Tests of the Honest John Lightweight Helicopter Transportable (Chopper John) System at Eglin Air Force Base, Florida," Army Rocket and Guided Missile Agency, Argma-TN-1E146-8, AD-472-752, November 1959.

31. Burpo, F. and Kawa, M., "Test of an Experimental Helicopter De-Icing System on an H-13H Helicopter.Part II.Results of Tests of the Experimental Helicopter Deicing System on Mt.Washington," NOAS58 109C, AD-242-231, September 1958.

32. Burpo, F. and Kawa, M. M., "Test of an Experimental Helicopter Deicing System on an H-13H Helicopter.Part III.Results of Tests of the Experimental Helicopter Deicing System in the Eglin Air Force Base Climatic Hangar," NOAS58, AD-242-232, 1969.

33. Burpo, F., "Test of an Experimental Helicopter De-Icing System in an H-13 Helicopter.Part IV.Summary of the Results of Tests of the Experimental Helicopter De-Icing System at: 1. National Aeronautical Establishment Spray Tower, Ottawa, Canada. 2. Mt. Washington. 3. Eglin Field Climatic Hangar," NOAS58 109C, AD-242-233, August 1959.

34. Campbell, C. W., White, B. L., and Mouser, W. G., "Extreme Low Temperature Evaluation of an H-43B Helicopter in the Climatic Laboratory," ASD TN-60 147, AD-240-168.

35. Carpenter, Ward, and Robbins, "Limited Artificial and Natural Icing Test of the DV-1D (Re-evaluation), Final Report," USAAEFA-81-21, June, 1982.

36. Casimiro, T. P., "Functional Cold Weather Test of the HSS-2 Helicopter, S/N 148035," Report No. SER-61523, Sikorsky Aircraft Division of United Aircraft Corporation, October 1961.

37. Casimiro, T., "H-34 Rotor De-Icing System, Test of," AD-234-677L.

38. Chambers, Harry W. and Adams, John, Y., "Summary of Artificial and Natural Icing Tests Conducted on U.S.Army Aircraft from 1974 to 1985," DOT/FAA/CT-85/26, TR-85-F-11, FAA Technical Center and U.S.Army Aviation Systems Command, July 1985.

39. Coffman, Jr., H. J., "Review of Helicopter Icing Protection Systems,"AIAA 83-2529, October 1, 1983.

40. Colley, I. H., Price, R. D., Ringer, T. R., Stallabrass, J. R., and Thomasson, F. T., "Hazards of the Helicopters," AGARD Aeromed.Aspects of Helicopter Operation in the Tactical Situation, May 1967.

41. Cooms, C. P.and Stanford, R. E., "Category II Climatic Laboratory Reevaluation of a YCH-47A Helicopter," ASD TDR63 948, AD-436-113, March 1964.

42. Cotton, R. H., "Icing Tests of a UH-1H Helicopter with an Electro-thermal Ice Protection System Under Simulated and Natural Icing Conditions," LR-28667, USARTL-TR-78-48, AD-A067-737/7SL, April 1979.

43. Cotton, R. H., "Ottawa Spray Rig Tests of an Ice Protection System Applied to the UH-1H Helicopter," Lockheed-California Co., LR-27694, USAAMRDL-TR-76-32, AD-A034-458/0SL, November 1976.

44. Cotton, R. H., "Natural Icing Flight Tests and Additional Simulated Icing Tests on a UH-1H Helicopter Incorporating an Electro-thermal Ice Protection System," USAAMRDL-TR-77-36, Final Report for Period 17 February 1977 - 15 April 1977, Prepared for Applied Technology, U.S.Army Research and Technology Laboratories (AVRADCOM), Fort Eustis, VA., 23604, July 1978.

45. Cotton, R. H., "Ottawa Spray Rig Tests of an Ice Protection System Applied to the UH-1H Helicopter," USAAMRDL-TR-76-32, AD-A034-458, Nov.1, 1976.

46. Don, T. C., "Helicopter Icing Symposium, 6-7 November 1978, London,"Ministry of Defense, London, AD-A067-981/1SL, November 1978.

47. Dostal, Capt. G. C., "Adverse Weather Testing of the CH-3C Helicopter," Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson Air Force Base, Technical Report ASD-TR-64-92, April 1965.

48. Dowden, D. J., Etzel, G. A. M., and Lovrien, Jr., C. E., "Category II Icing Test of the HH-53C Helicopter," AFFTC-TR-71-24, AD-893-311/1SL, June 1971.

49. Dowden, J. D. and Angle, T. E., "UH-1H Instrument Flight, Turbulence, and Icing Tests," AFFTC-TR-71-9, AD-889-752/2SL, March 1971.

50. Dunford, P. and Finch, R., "HC-MK1 (Chinook) Heated Rotor Blade Icing Test, Part II, Analysis of Atmospheric Conditions, Aircraft and Systems Characteristics," Paper No. 105, 10th European Rotocraft Forum, August 1984.

51. Dunford, P. J., "New Techniques for Optimization and Certification of Helicopters in Icing Conditions," AHS National Specialist's Meeting on Helicopter Testing Technology, October 1984.

52. Dunford, P., et al, "HC-MK1 (Chinook) Heated Rotor Blade Icing Test Part II Analysis of Atmospheric Condition Aircraft and System Characteristics," 10th European Rotorcraft Forum 105, Aug. 1, 1984.

53. Etzel, G. A., Barbagallo, J. L., and Lovrien, C. E., "Category II Arctic Tests of the HH-53C Helicopter," FTC-TR-71-12, April 1971.

54. Finn, B. B., Fulton, G. W., Stark, E. D., Gelling, W. C., and Langdon, D. J., "CH-113 Flight Test Program," Central Experimental and Proving Establishment, Rockliffe, Ontario, AD-456-092, November 1964.

55. Flemming, R. J., et al, "Correlation of Airfoil Icing Relationships With Two-Dimensional Model and Full Scale Rotorcraft Icing Test Data," AIAA 85-0337, Jan. 14, 1985.

56. Flemming, R. J. and Lednicer, D. A., "Experimental Investigation of Ice Accretion on Rotorcraft Airfoils at High Speeds," Paper AIAA-84-0183, AIAA 22nd Aerospace Sciences Meeting, January, 1984.

57. Flemming, R. J. and Lednicer, D. A., "Correlation of Airfoil Icing Relationship With Two-Dimensional Model and Full Scale Rotorcraft Icing Test Data," Paper AIAA-85-0337, AIAA 23rd Aerospace Sciences Meeting, January 1985.

58. Frankenberger, C. E., "United States Army Helicopter Icing Qualification 1980," AIAA Paper 81-0406, 19th AIAA Aerospace Sciences Meeting, January 1981.

59. Gibbings, D., "Development for Helicopter Flight in Icing Conditions," AGARD Conference Proc. No. 299, Subsystem Testing and Flight Test Instrumentation, Paper 19, pp.1-12, 1981.

60. Griffith II, W. E. and Brewer, L. K., "Helicopter Icing Handling Qualities," AHS, 30th Annual V/STOL Forum, Proc., Prepr.Paper 844, May 7-9, 1974.

61. Griffith II, W. E. and Hanks, M. L., "US Army Helicopter Icing Tests,"Proc. of the Soc. of Flight Test Eng., 5th Annual Symp.pp. 47-61, 1974.

62. Griffith II, W. E., Hanks, M. L, Mittag, C. F., and Reid, J. S., "Natural Icing Tests.UH-1H Helicopter," Army Aviation Systems Test Activity, Edwards AFB, USAASTA-74-31, June 1974.

63. Griffith II, W. E., Smith, R. B., Brewer, L. K., Hanks, M. L., and Reid, J. S., "Artificial Icing Tests UH-1H Helicopter. Part I," USAASTA-73-04-4, AD-779-503, January 1974.

64. Griffith II, W. E., "Artificial Icing Tests UH-1H Helicopter, Part II,Heated Glass Windshield," USAASTA-73-04-4, AD-779-503/2, Jan. 1, 1974.

65. Guffond, D., "Wind Tunnel Study of Icing and De-Icing on Oscillating Rotor Blades," Eighth European Rotorcraft Forum, Paper No. 6, September 1982.

66. Hagen, J. F., Tavares, E. J., and O'Connor, J. C., "Artificial Icing Test, Utility Tactical Transport Aircraft System (UTTAS), Boeing VERTOL YUH-61A Helicopter," USAAEFA-76-09-2, AD-A109-515/7, January 1977.

67. Hanks and Dickmann, "YAH-64 Icing Survey, Letter of Effort," U.S.Army Aviation Engineering Flight Activity, September 3, 1982.

68. Hanks, M. L.and Woratschek, R., "Limited Artificial and Natural Icing Tests of ESSS Installed on a UH-60A Aircraft, Final Report," USAAEFA-83-22, Unpublished.

69. Hanks, M. L., Diekmann, V. L., and Benson, J. D., "Limited Artificial and Natural Icing Tests Production UH-60A Helicopter (Re-evaluation)," USAAEFA-80-14, AD-A112-582/2, August 1981.

70. Hanks, M. L., et al, "Artificial and Natural Icing Tests of a Production UH-60A Helicopter - Etc.(u)," Army Aviation Engineering Flight Activity Edwards AFB, CA., USAAEFA-79-19, AD-A090-527, Oct. 1, 1979.

71. Hanks, M. L., Higgins, L. B., and Diekmann, V. L., "Artificial and Natural Icing Tests, Production UH-60A Helicopter - Final Report," USASEFA Project No. 79-19, June 1980.

72. Hanks, Reid, and Merrill, "Artificial Tests AH-16 Helicopter (U).FinalReport," USAAEFA-73-04-7, January 1974.

73. Hanson, M. K., "Documentation of Ice Accretion Shapes from Helicopter Icing Flight Tests at Duluth, Minnesota During February and March, 1984," Fluidyne Engineering Corporation Report.

74. Haworth, Graham, and Kimberly, "JUH-1H Redesigned Pneumatic Boot De-Icing System Flight Test Evaluation," January 14 - March 3, 1984.

75. Haworth, L. A. and Graham, M. S., "Flight Tests of the Helicopter Pneumatic Deicing System," AHS National Specialists Meeting, October 1984.

76. Haworth, L. A. and Oliver, R. G., "JUH-1H Pneumatic Boot Deicing System Flight Test Evaluation," USAAEFA-81-11, May 1983.

77. Haworth, L. and Graham, M. S., "Flight Tests of the Helicopter Pneumatic Boot Deicing System," 41st American Helicopter Society Forum.May 1985.

78. Heines, J. M. H. and Bailey, D. L., "Comparative Tests of Sample Electro-Thermal De-Icing Pad for a Helicopter," NRC Test Report MET-148, August 1957.

79. Heines, J. M. H., "Comparative Tests of Two Sample Electro-Thermal Helicopter Rotor De-Icing Pads Mounted on a Model Rotor," NRC Report LR-167, April 1956.

80. House, R. L. and Shonet, H. H., "CH-53A Anti-icing Systems," Proc. of the 6th Annual Natl. Conf. on Environ.Effects on Aircraft and Propulsion Systems, Rept. 66-ENV-4, 1966.

81. House, R. L., et al, "Development and Certification Testing of Turbine Powered Helicopters for Operation in Falling and Blowing Snow," DOT/FAA/CT-82/99, June 1, 1982.

82. Jones, C., Battersby, M. G., and Curtis, R. J., "Helicopter Flight Testing in Natural Snow and Ice," AIAA-83-2786, November 1983.

83. Kawa, M. W. and Burpo, F., "Test of an Experimental De-Icing System on a H-13H Helicopter.Part I.Results of Test of the Experimental Helicopter De-Icing System in the NAE Spray Tower at Ottawa, Canada," NOAS58 1O9C, AD-242-230, May 1958.

84. Kitchens, P. F. and Adams, R. I., "Simulated and Natural Icing of an Ice Protected UH-1H," Presented at 33rd Annual National Forum of the American Helicopter Society, Washington D. C., Preprint No.77-33-25, May 1977.

85. Kitchens, P. F., "Test Plan for Simulated and Natural Icing Tests of a UH-1H With an Advanced Ice Protection System," Applied Technology Laboratory, U. S.Army Research and Technology Laboratories (AVRADCOM), Fort Eustis, Virginia 23604, January 1978.

86. Koegeboehn, L. P., "Rotorcraft Icing-Status and Prospects," AGARD AR-166,Jan. 1, 1981.

87. Korkan, K. D., "Performance Degradation of Propeller/Rotor Systems Due to Rime Ice Accretion," NASA Lewis Research Center Icing Analysis Workshop, March 1981.

88. Korkan, K. D., Cross, Jr., E. J., and Cornell, C. C., "Experimental Study of Performance Degradation of a Model Helicopter Main Rotor With Simulated Ice Shape," AIAA Paper No.84-0184, presented at the 22nd Aerospace Sciences Meeting, Reno, Nevada, January 9-12, 1984.

89. Korkan, K. D., Dadone, L., and Shaw, R. J., "Performance Degradation of Propeller/Rotor Systems Due to Rime Ice Accretion," AIAA Paper No.82-0286, 1982.

90. Korkan, K. D., Dadone, L., and Shaw, R. J., "Performance Degradation of Propeller Systems Due to Rime Ice Accretion," AIAA J. of Aircraft, Vol.21, No. 1, January 1984.

91. Korkan, K. D., Dadone, L., and Shaw, R. J., "Performance Degradation of Helicopters due to Icing - A Review," 41st Annual American Helicopter Society Forum and Technological Display, Tarrant County Convention Center, Ft. Worth, Texas, May 16-17, 1985.

92. Korkan, K. D., Dadone, L, and Shaw, R. J., "Helicopter Rotor Performance Degradation in Natural Icing Encounter," Journal of Aircraft, Volume 21, No. 1, January 1984.

93. Korkan, K. D., Narramore, J. C., Dadone, L., and Shaw, R. J., "Performance Evaluation of the XV-15 Tilt Rotor Aircraft in a Natural Icing Encounter," AIAA Paper No. 83-2534, October 1983.

94. Krajeck, P. A., "Category II Low Temperature Evaluation of the CH-3C Helicopter in the Arctic," ASD TR-65-17, AD-482-622L, January 1966.

95. Kronenberger, Merrill, and Hanks, "Artificial Icing Tests, Lockheed Advanced Ice Protection System Installed on a UH-1H Helicopter," Final Report, U.S.Army Aviation Engineering Flight Activity, June 1975.

96. Lake, H. B.and Bradley, J., "The Problem of Certifying Helicopters for Flight in Icing Conditions," Aeronautical Journal, Vol. 80, 1976, pp.419-433.

97. Lane, W. A., "Ground Test Evaluation of H-34A Ice Control System," AD-234-681L.

98. Lee, J. D., Harding, R., and Palko, R., "Documentation of Ice Shapes on the Main Rotor of a UH-1H Helicopter in Hover," NASA CR-168332, January 1984.

99. Lovrien, Jr., C. E., "Category II Icing Test of the HH-53C Helicopter,"AFFTC-TR-71-26, AD-904-773/9SL, September 1, 1972.

100. Lunn, K. and Curtis, R., "HC-MK1 (Chinook) Heated Rotor Blade Icing Test, Part 1, Test Vehicle, Test Site, Approach and Summary of Testing," Paper No. 104, Tenth European Rotorcraft Forum, The Hague, The Netherlands, August 1984.

101. Marshall, L. B., "Adverse Weather Tests of the YUH-1D Helicopter," ASDTDR 63 414, AD-410-533.

102. McConnell, L. J., "Letter Report, Artificial and Natural Icing Test,"Production UH-60A Helicopter," USAAEFA 78-05, Oct. 1, 1979.

103. McKenzie, K. T. and Shepherd, D. R., "Design for Maximum Survival in Icing," Royal Aeronautical Society All-day Symposium on Icing on Helicopters, November 1075.

104. Minsk, L. D., "Some Snow and Ice Properties Affecting VTOL Operation," AHS, AIAA, and U. of Texas, Proc. of the Joint Symposium on Environmental Effects on VTOL Designs, Arlington, Texas, November 16-18, 1970.

105. Mittag, C. F., O'Connor, J. C., and Kornenberger, Jr., L., "Artificial Icing Tests CH-47C Helicopter, USAAEFA-73-04-1, AD-A-004-008/SL, August 1974.

106. Mittag, C. F., Smith, R. B., Hanks, M. L., and Reid, J. S., "Artificial Icing Tests AH-1G Helicopter," USAAEFA-73-04-2, AD-A009-712/1SL, November 1974.

107. Morris, P. M and Woratschek, R., "JUH-1H Ice Phobic Coating Icing Tests," Army Aviation Engineering Flight Activity, USAAEFA-79-02, AD-A096-361/1, July 1980.

108. Murphy, F. N. and Skillings, R. B., "Hiller CH112 Cold Weather Trials,"AD-446-225L, May 1964.

109. Niemann, J. R., et al, "Artificial Icing Test CH-47C Helicopter with Fiberglass Rotor," USAAEFA 78-18, AD-AO81-860, July 1, 1979.

110. Oaks, T., "Feasibility Study - EH101 Oscillating Blade Icing Test in NGTECell 3," Report G1/48965/1, Westland Helicopters Ltd.

111. Palko, R. L. and Cassady, P. L., "Photgrammetric Analysis of Ice Buildup on a U.S.Army UH-1H Helicopter Main Rotor in Hover Flight," AEDC-TR 83-43, October 1983.

112. Palko, R. L., Cassady, P. L., McKnight, R. C., and Freedman, R. J,, "Initial Feasibility Ground Test of a Proposed Photogrammetric System for Measuring the Shapes of Ice Accretions on Helicopter Rotor Blades During Forward Flight," AEDC-TR-84-1, Aug.1984.

113. Peterson, A. A. and Dadone, L., "Helicopter Icing Review," D210-11583-1,FAA-CT-80-210, AD-A094-175/7, September 1980.

114. Peterson, A. A. and Dunford, P. L., "Qualification of a Composite Rotor Balde Electrothermal Deicing System," Paper No. AIAA-84-2481, AIAA/AHS/ASEE Aircraft Design, System, and Operations Meeting, San Diego, California, November 1984.

115. Reilly, Capt. D. A., "Adverse Weather Tests of The HH-53C Helicopter," Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson Air Force Base, Technical Report ASD-TR-70-51, AD-861-186/ISL, December 1970.

116. Ringer, T. R., Stallabrass, J. R., and Price, R. D., "Icing and the Rescue Helicopter," AGARD Helicopter Symposium, Paris, France, May 22-24, 1967.

117. Robbins, R. D., "UH-60A Light Icing Envelope Evaluation with the Blade Deicing Kit Installed But Inoperative," USAAEFA-81-19, June 1, 1982.

118. Robertson, E. O., "Preliminary Helicopter Icing Flight Trials," NRC Report LR-106, July 1954.

119. Rodriquez, E. M., "Formacion De Hielo En Aviones," N84-15130/7.

120. Rosen, K. M. and Potash, M. L., "Forty Years of Helicopter Ice Protection Experience at Sikorsky Aircraft," J. Am. Helicopter Soc., Vol. 26, No. 3, pp.5-19, July 1981.

121. Rosen, K. M. and Potash, M. L., "Forty Years of Helicopter Ice Protection Experience at Sikorsky Aircraft," AIAA Paper 81-0407, 1981.

122. Ryder, P., "The Role of Meteorology in Helicopter Icing Problems,"Meteorological Magazine, 1978, Vol. 107, pp. 140-147.

123. Shaw, R. J. and Ritcher, G. P., "The UH-1H Helicopter Icing Flight Test Program: An Overview," AIAA Paper 85-0338, 1985.

124. Smith, E. D. and Flanigen, E. G., "UH-IF Category II Performance,"TR-65-5, AD-467-095, July 1965.

125. Smith, Mittag, Hanks, and Reid, "Artificial Icing Tests, AH-16 Helicopter.Final Report," USAAEFA-73-04-2, November 1974.

126. Somsel, J. R., "UH-1H Category II Test Program Summary," AFFTC-TR-72-29,AD-902-264/1SL, July 1972.

127. Stallabrass, J. R., "Icing Flight Trials of a Bell HTL-4 Helicopter," NRC Report LR-197, July 1957.

128. Stallabrass, J. R., "Icing Flight Trials of a Sikorsky H045-2 Helicopter," NRC Report LR-219, April 1958.

129. Stallabrass, J. R., "Flight Tests of an Experimental Helicopter Rotor Blade Electrical De-Icer," NRC Report LR-263, November 1959.

130. Stallabrass, J. R., "Canadian Research in the Field of Helicopter Icing," The Journal of the Helicopter Association of Great Britain, Vol. 12, No.4, 1961.

131. Stanford, R. E. and Griggs, D. B., "Category II Arctic Evaluation of the YCH-47A Helicopter," ASD-TDR-64-86, AD-611-581, December 1964.

132. Tavares, Hanks, Sullivan, and Woratschek, "Artificial and Natural Icing Tests YEH-60A Quick Fix Helicopter, Final Report," USAAEFA-83-21, unpublished.

133. Thompson, "Service Test of the YHU-1D Helicopter," (Hi) Fiber Glass Co., AATB AVN1562, AD-405-552L, May 1963.(Notice: All Requests require approval of Army Materiel Command, Washington, D. C.)

134. Tulloch, J. S., et al, "Artificial Icing Test Utility Tactical Transport Aircraft System (UTTAS) Sikorsky YUH-60A Helicopter," USAAEFA 76-09-1, AD-A109-530/6, Feb. 1, 1977.

135. Tulloch, J. S., Smith, R. B., Dolen, F. S., and Bishop, J. A., "Artificial Icing Test Ice Phobic Coatings on UH-1H Helicopter Rotor Blades," USAAEFA Project No. 77-30, U.S. Army Aviation Engineering Flight Activity, Edwards Air Force Base, California, AD-A059-875/5SL, June 1978.

136. Tulloch, Mullen, and Belte, "Artificial and Natural Icing Tests, Production UH-60A Helicopter, Letter Report," USAAEFA-78-05, October 1979.

VIII.11.0 HELICOPTER ICING AND CLIMATIC TESTS (CONTINUED)

137. Van Wyckhouse, J., "Liquid Ice Protection System Development and Flight Test of a Liquid and Electro-thermal Ice Protection System for the Rotor of the HU-1 Series Helicopter," Bell Helicopter Co., November 8, 1960.

138. Van Wyckhouse, J., and Lynn, R. R., "Development and Icing Flight Tests of a Chemical Ice Protection Systems for the Main and Tail Rotors of the HU-1 Helicopter," Bell Reports 518-099-001 and 518-099-002, 5 June 1961.

139. White, B. L., "Category II Low Temperature Evaluation of a YUH-1D Helicopter in the Arctic," ASD-TDR-63-564, N64-12680, AD-422-643.

140. White, B. L., "Category II Climatic Laboratory Test of the CH-3C Helicopter," ASD-TR-64-89, AD-465-084, May 1965.

141. Wilcox, K. H., "Environmental Testing of the Improved Engine and Windshield Anti-Ice and Rotor Blade Deice Systems Installed in the CH-46A Helicopter," Naval Air Test Center, NATC-ST-18R-66, AD-A011-116/1SL, March 7, 1966.

142. Wilson, G. W. and Woratschek, R., "Microphysical Properties of Artificial and Natural Clouds and their Effects on UH-1H Helicopter Icing," USAAEFA-78-21-2, AD-A084-633/7, August 1979.

143. Wilson, G. W. and Woratschek, R., "Artificial and Natural Icing Tests for Qualification of UH-1H Kit A Aircraft Letter Report," USAAEFA 78-21, August 1979.

144. Wilson, G. W., "Helicopter Icing - Testing and Certification," Journal of Americal Helicopter Society, Vol. 27, No.22, 1982.

145. Wright, D. E., "Rotary Wing Icing Symposium Summary Report Volume I,"USAAEFA 74-77, AD-A061-445/3, June 6, 1974.

146. Wright, D. E., "Rotary Wing Icing Symposium Summary Report Volume II," JSAAEFA 74-77, AD-A061-423/D, June 6, 1974.

CHAPTER VIII
SECTION 12.0

HELICOPTER ROTOR BLADE ICING

BIBLIOCRAPHY

VIII.12.0 HELICOPTER ROTOR BLADE ICING

1. "An Estimate of the Aerodynamic Hazards of Ice Accretions on Helicopter Rotors," Cornell Aero Lab, Report No. HB-873-A-2, WADC TR-58-286, AD-155-617.

2. "Artificial Icing Tests, Lockheed Advanced Ice Protection System Installed on a UH-1H Helicopter," USAAEFA Project No. 74-13, Final Report, U. S. Army Aviation Engineering Flight Activity, Edwards Air Force Base, California, June 1975.

3. "Certification of Transport Category Rotorcraft," U. S. Department of Transportation, Federal Aviation Administration, AC 29-2, May 20, 1983.

4. "CH-113, CH-46A, CH-53A Investigations, Ice Protection Systems," AD-802-952.

5. "Rotor Blade Electro-thermal Ice Protection Design Considerations,"SAE-AIR-1667 Draft,January 1985.

6. "Rotor Blade Electro-thermal Ice Protection Design Considerations,"SAE-AIR 1667, April 22, 1985.

7. "Rotorcraft Icing-Status and Prospects," AGARD AR-166, Aug. 1, 1981.

8. "Rotorcraft Regulatory Review Program Notice No. 1: Proposed Rulemaking,"Dec. 1, 1980.

9. Abbott, W. Y., "Evaluation of UH-1H Hover Performance Degradation Caused by Rotor Icing," USAAEFA-81-11, May 1983.

10. Abbott, W. Y.,et al, "Evaluation of UH-1H Hover Performance Degradation Caused by Rotor Icing," USAAEFA Project 82-12, Final Report, August 1983.

11. Abbott, W. Y., Linchan, J. L., Lockwood, R. A., and Todd, L. L., "Evaluation of UH-1H Level Flight Performance Degradation Caused by Rotor Icing," USAAEFA Project No. 83-23, July 1984.

12. Armand, C., et al, "Icing Testing in the Large Modane Wind Tunnel on a Reduced-Scale Model of a Helicopter Rotor," CRREL-TL-523, May 1, 1976, AD-A030-110.

13. Artis, Jr., D. R., "Ice4hobic Coatings for Army Rotary-Wing Aircraft," USAAMRDL-TN-19, AD-B004-715/9SL, May 1975.

14. Barlett, G. C., "Summary of Studies of Helicopter Rotor Icing," Cornell Aero Lab., Rept. No. HB-973-A-3., September 1959.

15. Blaha, B. J. and Evanich, P. L., "Pneumatic Boot for Helicopter Rotor De-Icing," NASA CP-2170, November 1980.

16. Boulet, J. and Lecoutre, J. C., "Ice Protection Systems of the Puma," Eur. Rotorcraft and Powered Lift Aircraft Forum, 4th, Paper 51, September 1978.

17. Burpo, F. and Van Wyckhouse, J., "Development and Ground Test of an Electro-Thermal Deicing System for the Main and Tail Rotors of the HU-1 Helicopter," AF33-608-36779, AD-241-661, May 1960.

18. Cansdale, J. T., "Helicopter Rotor Ice Accretion and Protection Research," Paper No. 33, Presented at the Sixth European Rotorcraft and Powered Lift Aircraft Forum, Bristol, England, September 16-19, 1980, Vertica, Vol. 5, pp. 357-368, 1981.

19. Clark, J. E., "UK Development of a Rotor Deicing System," Sixth European Rotorcraft and Powered Lift Aircraft Forum, September 1980.

20. Coffman, H. J., "Helicopter Rotor Icing Protection Methods," AHS 41st Annual Forum Procedings, May 1985.

21. Coyle, G. D., "Helicopter Rotor Blade Icing (Summary of Effort)," Aeronautical Systems Div., Wright-Patterson AFB, WADD-TR-60-241, AD-239-962.

22. Crick, R. D., "Electrical De-Icing of Helicopter Blades," Aircraft Ice Protection Conference, 1961.

23. Flemming, R. J., et al, "Experimental Investigation of Ice Accretion on Rotorcraft Airfoils at High Speeds," AIAA 84-0183, Jan. 9, 1984.

24. Flemming, R. J., et al, "The Performance Characteristics of Simulated Ice on Rotorcraft Airfoils," Report No. A-85-41-66-J000, AHS 41st Annual Forum Proceedings, May 1, 1985.

25. Flemming, R. J. and Lednicer, D. A., "High Speed Ice Accretion on Rotorcraft Airfoils," NACA Contractor Report 3910, 1985.

26. Flemming, R. J. and Lednicer, D. A., "High Speed Ice Accretion on Rotorcraft Airfoils," Paper A-83-39-04-0000, 39th Annual Forum of the American Helicopter Society, May 1983.

27. Flemming, R. J. and Lednicer, D. A., "Correlation of Airfoil Icing Relationships with Two-Dimensional Model and Full Scale Rotorcraft Icing Test Data," AIAA Paper 85-0337, 1985.

28. Flemming, R. J., "Application of Rotor Icing Analysis to the Design of 2 Rotorcraft De-Icing Systems," A-86042-79-J000, 42nd Annual Forum of the American Helicopter Society, June 1986, Washington, D.C.

29. Flemming, R. J., Shaw, R. J., and Lee, J. D., "The Characteristics of Simulated Ice on Rotorcraft Airfoils," AHS Paper A-85-41-66-J000, May 1985.

30. Gail, A., "An Estimate of the Aerodynamic Hazards of Ice Accretions on Helicopter Rotors," WADC Tech.Rep.58-286, AD-155-617, July 1958.

31. Gent, R. W. and Cansdale, J. T., "The Development of Mathematical Model-ling Techniques for Helicopter Rotor Icing," AIAA-85-336, January 1985.

32. Gent, R. W. and Cansdale, J. T., "1-Dimensional Treatment of Thermal Transients on Electrically Deiced Helicopter Rotor Blades," RAE TR 80159, December 1980.

33. Gent, R. W., Markiewicz, R. H., and Cansdale, J. T., "Further Studies of Helicopter Rotor Ice Accretion and Protection," Royal Aircraft Establishment, September 10-13, 1985.

34. Guffond, D. P., "Icing and De-Icing Test on a Down Scale Rotor in the ONERA SIMA Wind Tunnel," AIAA-86-0480, AIAA 24th Aerospace Sciences Meeting, Reno, Nevada, January 6-9, 1986.

35. Guffond, D., "Overview of Icing Research at ONERA," AIAA-85-335, January 1985.

36. Guffond, D., "Wind Tunnel Study of Icing and De-Icing on Oscillating Rotor Blades," Paper No. 6, Eighth European Rotorcraft Forum, September 1982.

37. Hanson, M. K. and Lee, John D., "Documentation of Ice Shapes Accreted on the Main Rotor of a UH-1H Helicopter in Level Flight," NASA CR 175088, Prepared for Lewis Research Center Under Grant NAG 3-´ 1, March 1986.

38. Hermes, H., "De-Icing System.. for Helicopters," AEG-Telefunken Progr.,No. 2, 1970.

39. Itagaki, K., "Mechanical Ice Release Processes: Self-Shedding From High-Speed Rotors," CRREL Report 83-26, October 1983.

40. Jellinek, H. H. G., et al, "Adhesion of Ice from Helicopter Rotor Blades," AD-P001-673/2.

41. Katzenberger, E. F., "Investigation of a Rotor Blade Thermal Ice-Prevention System for the H-5 Helicopter," Aero. Engr. Review, Vol. 10, pp.25-33, September 1951.

42. Korkan, K. D., "Performance Degradation of Propeller/Helicopter Rotor Systems Due to Rime Ice Accretion," NASA Lewis Research Center, Icing Analysis Workshop, March 1981.

43. Korkan, K. D., Cross, E. J., and Miller, T. L., "Performance Degradation of a Model Helicopter Main Rotor in Hover and Forward Flight with a Generic Ice Shape," AIAA Paper 84-0609, 1984.

44. Korkan, K. D., Cross, Jr., E. J., and Cornell, C. C., "Experimental Study of Performance Degradation of a Model Helicopter Main Rotor with Simulated Ice Shapes," AIAA Paper 84-0184, 1984.

45. Korkan, K. D., Cross, Jr., E. J., and Miller, T. L., "Performance Degradation of a Model Helicopter Rotor with a Generic Ice Shape," Journal of Aircraft, Vol. 21, No. 10, October 1984.

46. Korkan, K. D., Dadone, L., and Shaw, R. J., "Performance Degradation of Helicopter Rotor Systems in Forward Flight Due to Rime Ice Accretion," AIAA Paper 83-0029, 1983.

47. Korkan, K. D., Dadone, L., and Shaw, R. J., "Helicopter Rotor Performance Degradation in Natural Icing Encounter," Journal of Aircraft, Volume 21, No. 1, January 1984.

48. Korkan, K. D., Dadone, L., and shaw, R. J., "Performance Degradation of Helicopter Rotor in Forward Flight Due to Ice," Journal of Aircraft, Vol. 22, No. 8, August 1985.

49. Korkan, K. D., Dadone, L., and Shaw, R. J., "Performance Degradation of Propeller/Rotor Systems Due to Rime Ice Accretion," AIAA Paper No.82-0286, 1982.

50. Korkan, K. D., Dadone, L., and Shaw, R. J., "Performance Degradation of Helicopter Rotor Systems in Forward Flight Due to Rime Ice Accretion," AIAA 83-0028, January 1983.

51. Lake, H. B., "Helicopter Icing A Problem to be Defined," Paper No. 5, Second European Rotorcraft and Powered Lift Aircraft Forum, September 1976.

52. Larson, V. H. and Zdrazil, J. A., "Effects of Ice on Rotor Blades,"Research Inc., Rept. No. F4037, AD-202-299, April 25, 1958.

53. Lee, J. D. and Shaw, R. J., "Aerodynamics of Rotor Blades with Ice Shapes Accreted in Hover and in Forward Flight," 41st American Helicopter Society Forum, May 1985.

54. Lee, J. D., Aerodynamic Evaluation of a Helicopter Rotor Blade with Ice Accretion in Hover," AIAA Paper 84-0608, March 1984.

55. Lee, J. D., Hardin, R., and Palko, R., "Documentation of Ice Shapes on the Main Rotor of a UH-1H Helicopter in Hover," NASA CR-168332, January 1984.

56. Lemont, H. E. and Upton, H., "Vibratory Ice Protection for Helicopter Rotor Blades," USAAMRDL-TR-77-29, Applied Technology Laboratory, U.S.Army Research and Technology Laboratories (AVRADCOM), Fort Eustis, Virginia, July 1978.

57. Lemont, H. E., "XH-16 Blade De-Icing for All-Weather Operation," Vertol Aircraft, Rept. No. 15-X-19.

58. Maggenheim, B. and Hains, F., "Feasibility Analysis for a Microwave DeIcer for Helicopter Rotor Blades," USAAMRDL-TR-76-18, Eustis Directorate, U.S.Army Mobility Research and Development Laboratory, Fort Eustis, Virginia, May 1977.

59. McJones, R. W., "Helicopter Rotor Anti-Icing Utilizing Hot Air from a Pulse-Jet Cooling Shroud," American Helicopter Co., Inc., Rept.No.172-D-1, ASTIA AD-18203, April 1953.

60. Miller, Jr., K. D., "Power Requirements for Helicopter Cyclic De-Icing and Appendix A, Final Report," Princeton Univ., Aero.Engr.Lab., Report No. 165.

61. Oleskiw, M. M. and Lozowski, E. P., "Helicopter Rotor Blade Icing: A Numerical Simulation," 3rd WMO Scientific Conference on Weather Modification, Clermont-Ferrand, July 1980.

62. Olsen, W. A., et al, "Ice Shapes and the Resulting Aero Penalty for aTypical Helicopter Airfoil," AIAA 84-0109, Jan. 1, 1984.

63. Palko, R. L., et al, "Initial Feasible Ground Test of a Proposed Photogrammetric System for Measuring the Shapes of Ice Accretions on Helicopter Rotor Blades During Forward Flight," AEDC-TR-84-10, Aug.1, 1984.

64. Peterson, A. A., "A Review of Rotor Icing Evaluation Methods," AHS National Specialists' Meeting on Rotor System Design, October 1980.

65. Peterson, A. A., "Thermal Analysis Techniques for Design of VSTOL Air-craft Rotor Ice Protection," AIAA-85-340, January 1975.

66. Peterson, A. A., "VSTOL Aircraft Ice Protection Design Considerations,"AHS 41st Annual Forum Procedings, May 1985.

67. Peterson, A. A., "CH-47 Composite Rotor Thermal Analysis During Electro-Thermal Deicing Activation," Boeing Vertol Report D210-12253-1, September 1983.

68. Peterson, A. A., Dadone, L., and Bevan, D., "Rotorcraft Aviation Icing Research Requirements," Research Review and Recommendations," NACA CR-165344, May 1981.

69. Peterson, A. A., et al, "Qualification of a Composite Rotor Blade Electro-thermal Deicing System," AIAA 84-2481, Oct. 31, 1984.

70. Richardson, D. A., et al, "Solutions for Helicopter Rotor Blade Icing,"JAS Paper 810, 1958.

71. Sewell, J. H. and Osborn, G., "Hybrid Heater/Paste and Heater/Flexible Coating Schemes for De-Icing Helicopter Rotor Blades," Eur.Rotorcraft and Powered Lift Aircraft Forum, 4th, Paper 53, September 1978.

72. Sewell, J. H., "Development of an Ice-Shedding Coating for Helicopter Rotor Blades," Royal Aircraft Establishment, RAE-TR-71238, December 1971.

73. Shepherd, D. R., "Rotor Ice Protection Systems," Paper No. 6, Second European Rotorcraft and Powered Lift Aircraft Forum, September 1976.

74. Stallabrass, J. R. and Gibbard, G. A., "A Comparison Between the Spanwise and Chordwise Shedding Methods of Helicopter Rotor Blade De-Icing," NRC Report LR-270, January 1960.

75. Stallabrass, J. R. and Lozowski, E. P., "Ice Shapes on Cylinders and Rotor Blades," NATO Armaments Group, Panel X, Helicopter Icing Symposium, London, November 1978.

76. Stallabrass, J. R. and Price, R. D., "The Effect of Icing During Helicopter Ground Run-Up," NRC Test Report MET-491, April 1967.

77. Stallabrass, J. R. and Price, R. D., "Icing Induced Structural Problems," Joint AHS-AIAA-UTA Symposium on Environmental Effects of VTOL Designs, Univ. of Texas, Arlington, Texas, November 17, 1970.

78. Stallabrass, J. R., "Helicopter Icing Research," NRC DME/NAE Quarterly Bulletin 1957(2), April-June 1957.

79. Stallabrass, J. R., "Some Aspects of Helicopter Icing," Canadian Aero-nautical Journal, Vol. 3, No. 8, pp. 273-283, October 1957.

80. Stallabrass, J. R., "General Review of Helicopter Icing," International Helicopter Icing Conference, Ottawa, May 23-25, 1972.

81. Stallabrass, J. R., "Canadian Research in the Field of Helicopter Icing," The Journal of the Helicopter Association of Great Britain, Vol. 12, No.4, 1961.

82. Stallabrass, J. R., "Review of Icing Protection for Helicopters," NRC LR-334, Canada.

83. Stallabrass, J. R., "Thermal Aspects of De-Icer Design," Presented at the International Helicopter Icing Conference, Ottawa, May 23-25, 1972.

84. Treanor, C. E. and Williams, M. J., "Computed Moisture Interception on Helicopter Rotor Blades," June 1978.

85. Tulloch, J. S., Smith, R. B., Doten, F. S., and Bishop, J. A., "Artificial Icing Test Ice-Phobic Coatings on UH-1H Helicopter Rotor Blades," USAAEFA-77-30, U.S.Army Aviation Engineering Flight Activity, June 1978.

86. Van Wyckhouse, J. F., "Summary of Ice Protection System Development and Testing for Helicopter Rotors," Bell Helicopter Co., Rept. No. 6529-099-001, August 4, 1961.

87. Wagner, K., "Ice Formation at Helicopters," Flugrevue/Flugwelt International, pp. 31-34, Sept. 1971. (In German.)

88. Wagner, K., "Icing on Helicopters," Flugrevue/Flugwelt International, July 1977.

89. Ward, N. R., "U. S. Army Helicopter Icing Developments," SAE Technical Paper 821504, October 1982.

90. Ward, R., "Rotorcraft Icing Technology - An Update," AD-P002-702 June 1,1983.

91. Warner, E. V. Lt., "Helicopter Rotor-Blade Ice Detection," U. S. Army Transportation Research Command, Fort Eustis TCREC Technical Report 61-98, August 1961.

92. Warner, J.B., "The Development of an Advanced Anti-Icing/Deicing Capability for U.S.Arny Helicopters.Volume II.Ice Protection System Application to the UH-1H Helicopter," LR-27180-V0L-2, USAAMRDL-TR-75-34B, AD-A019-049/6SL, November 1975.

93. Warner, J. B., "Ice Protection Investigation for Advanced Rotary-Wing Aircraft," LR-25327-10, U.S. Army Air Mobility Research and Development Laboratory, USAAMRDL-TR-73-38, AD-A771-182/3, August 1973.

94. Werner, J. B., "The Development of an Advanced Anti-Icing/De-Icing Capability for U.S. Army Helicopters, Vol. I, Design Criteria and Technology Considerations," USAMRDL-TR-75-34A, 1975.

95. Werner, J. B., "Ice Protection Investigation for Advanced Rotary-Wing Aircraft," USAAMRDL Technical Report 73-38, 1973.

96. Williams, P. J., "The Design and Evaluation of a Prototype Ice Protection System for the H-34A Helicopter," Sikorsky Aircraft, Stratford, Conn, AD-234-678L.

97. Williams, P. J., "The Design of a Prototype Ice Protection System for the H-34A Helicopter," AD-234-679L, Sikorsky Aircraft, Stratford, Conn.

98. Wright, D. E., "Rotary Wing Icing Symposium.Summary Report.Volume I,"USAAEFA-74-77-VOL-I, AD-A061-445/3SL, June 6, 1974.

99. Wright, D. E., "Rotary Wing Icing Symposium.Summary Report.Volume II," USAAEFA-74-77-VOL-2, AD-A061-422/2SL, June 6, 1974.

100. Wright, D. E., "Rotary Wing Icing Symposium. Sumary Report. Volume III," USAAEFA-74-77-VOL-3, AD-A061-423/OSL, June 6, 1974.

101. Young, C., "Theoretical Study of the Effect of Blade Ice Accretion on the Power-Off Landing Capability of a Wessex Helicopter," Vertica, Vol.2, No. 1, pp. 11-25, 1978.

CHAPTER VIII

SECTION 13.0

ENGINE SNOW INGESTION AND SNOW MEASUREMENTS

BIBLIOGRAPHY

VIII.13.0 ENGINE SNOW INGESTION AND SNOW MEASUREMENTS

1. "Annotated Bibliography on Snow, Ice and Permafrost," SIPRE, Report 12,September 1951.

2. "Preliminary Measurements of Snow Concentration," NRC Report LTR-LT-42,September 1972.

3. "Problems in Winter Operation," Skyways, Vol.13, pp.18-21, January 1954.

4. Bender, D., "Tests Under Snow and Icing Conditions with the BO 105 Engine Installation," AGARD Conference Proc. No. 236, Ice Test for Aircraft Engines, Paper 10, April 3-4, 1978.

5. Bilello, M. A., "Surface Measurements of Snow and Ice for Correlation with Aircraft and Satellite Observations," CRREL-SR-127, AD-689-449, May 1969.

6. Harms, W., "Removing a Snow Restriction," Shell Aviation News No. 371,pp. 22-3, 1969.

7. House, R. L., et al, "Development and Certification testing of Turbine-Powered Helicopters for Operation in Falling and Blowing Snow," DOT/FAA/ CT-82/99, June 1982.

8. Jones, C., Battersby, M. G., and Curtis, R. J., "Helicopter Flight Testing in Natural Snow and Ice," AIAA-83-2786, November 1983.

9. Minsk, L. D., "Some Snow and Ice Properties Affecting VTOL Operation," AHS, AIAA, U. of Texas, Proc. of Joint Symposium on Environmental Effects on VTOL Designs, Arlington, TX., November 16-18, 1970.

10. Nakaya, U., Sato, I., and Sekido, Y., "Preliminary Experiments on the Artificial Production of Snow Crystals.Investigations on Snow," Journal of Faculty Science, Hokkaido Imperial Univ., Ser. II, No.10, 2, pp.1-11, March 1938.

11. Stallabrass, J. R., "Engine Snow Ingestion in the Bell 206A Jet Ranger Helicopter," NRC Test Report MET-513, January 1971.

12. Stallabrass, J. R., "The Airborne Concentration of Falling Snow," NRCDME/NAE Quarterly Bulletin 1976(3), July-September 1976.

13. Stallabrass, J. R., "Snow Concentration Measurements and Correlation with Visibility," AGARD Conference Proc. No. 236, Icing Testing for Aircraft Engines, Paper 1, London, 1978.

14. Stallabrass, J. R., "Airborne Snow Concentration and Visibility," U.S.Transportation Research Board Special Report 185, Snow Removal and Ice Control Research, pp.192-199, 1979.

15. Wyganowski, J., "Snow Removal and Deicing of Transport Aircraft," Technika Lotnicza i Astronautyczna, Vol. 25, pp. 28-33.(In Polish.)

CHAPTER VI II

SECTION 14.0

ICE DETECTION AND PROTECTION SYSTEMS

BIBLIOGRAPHY

VIII.14.0 ICE DETECTION AND PROTECTION SYSTEMS

1. "A Compilation of the Papers Presented by NACA Staff Members," NACA Conference on Aircraft Ice Prevention, June 26-27, 1947.

2. "Aircraft Anti-Icing/De-Icing Final Report," Army Test and Evaluation Command, Aberdeen Proving Ground, MTP-7-3-528, AD-724-082, March 24, 1971,

3. "Aircraft Anti-Icing/De-Icing," Army Test and Evaluation Command,TOP-7-3-528, AD-A074-128/0, August 31, 1979.

4. "Aircraft Ice Protection - Report of Symposium," Engineering and Manufacturing Division Flight Standards Service, Department of Transportation, April 28-30, 1969.

5. "Aircraft Ice Protection," Department of Transportation, Federal Aviation Administration, AC No. 20-73, April 21, 1971.

6. "Aircraft Ice Protection," Electrical Journal, Vol. 152, pp. 1092-1094,April 1954.

7. "Aircraft Icing - Objective Measurement and Classification," International Civil Aviation Organization, 1955.

8. "Aircraft Icing Avoidance and Protection," National Transportation Safety Board, Bureau of Technology, NTSB-SR-81-1, September 9, 1981.

9. "Aircraft Icing," NASA Conference Publication 2086 (FAA-RD-78-109), July 1978.

10. "Airplane De-Ice and Anti-Icing Systems," U.S.Department of Transportation, Federal Aviation Administration, AC 91-51, September, 1977.

11. "An Analysis of the Thermal Anti-Icing System for the F-86D Interceptor Airplane," North American Aviation, Inc., Rept.NA-5O-4O.

12. "An Investigation of Methods for the De-Icing of Aircraft," Contract No. W33-038 ac 336(11069), Final Report, M.I.T.Lab., June 1944.

13. "Anti-Icer for Airplanes with Special Regard to Electrical Systems,"Presented at 52nd Stuttgart Aviation Discussion, November 6, 1961.

14. "Anti-Icing and Defrosting Systems," Aviation Age, Vol. 13, pp. 20-21,April 1950.

15. "Anti-Icing Equipment for Aircraft, General Specifications (Heated Surface Type)," Army Air Forces Specification No.R-40395, A.A.F., April 1942.

16. "Application of Pneumatics for Aircraft De-Icing System," Applied Hydraulics, Vol. 5, pp. 102-104, March 1952.

17. "Breathing Rubber Tubes Rid Planes of Ice," Compressed Air Magazine,Vol. 57, pp. 102-103, April 1952.

18. "Comparison of Heated Air and Electrical Thermal Anti-Icing Systems for Two-Engine Airplanes," Curtiss-Wright Corp., C-1710, June 1947.

19. "Cyclic Electro-Thermal De-Icing for the F-94C," Lockheed Report No. 7853.

20. "De-Icing Heater Element Applied by Spraying," Aircraft Engineering, Vol. 60, April 1954.

21. "De-Icing with Sprayed Metal," Electroplating, Vol.7, April 1954.

22. "De-Icing," Aircr. Engr., Vol. 46, No. 6, pp. 20-21, June 1974.

23. "Description of F-89 Anti-Icing System," Northrop Service News, September 1953.

24. "Developments in Icing Protection Systems at the Lockheed Aircraft Corp. in 1955," Lockheed Aircraft Corp., 1955.

25. "Economical De-Icing," Flight, Vol. 58, pp. 468, Nov. 1950.

26. "F-89 Heat Anti-Icing Performance: Empennage," Northrop Rept.No. A-68-II.

27. "First Interim Report on the Cyclic De-Icing Tests of the F-94B Aircraft," AIRL A6138 51-2-1, May 1951 with Appendix III, A6138 51-3-2, July 1951 with Appendix III, Aeronautical Icing Research Laboratory.

28. "German De-Icing Technique," Ministry of Aircraft Production, England, R.T.P.2 616, Reports on Development.

29. "Head on CV De-Ices the Corsair," Aviation Week, Vol.55, December 1951.

30. "Heat Anti-Icing Supply System," Northrop Report No.A-68-IV.

31. "Heating Pad De-Icer Flaps on B-36 Jets," Aviation Week, Vol.53, November 1950.

32. "Ice Prevention and Removal, Bibliography," Aero.Engr.Rev., July 1952.

33. "Ice Protection for Turbo-Jet Transport Airplane," Meteorological and Physics of Icing, Determination of Heat Requirements, Thermal Anti-Icing Systems for High-Speed Aircraft," SMF Fund Paper FF-1, Inst.Aero.Sciences, March 1950.

34. "Icing of Aircraft and the Means of Preventing It," FTD-MT-65-490, AD-668-521, Aug. 29, 1967.

35. "Investigation of C-124 Anti-Icing Deficiencies," WADC TR 54-58, June 24, 1954.

36. "Mechanical De-Icer Equipment," Aviation Eng. Soc. of Aero. Digest, Vol. 27, No. 2, pp. 34-35, August 1935.

37. "Melt-Proof Ice," Boeing Magazine, Vol. 30, II, 1960.

38. "Military Specification - Anti-Icing Equipment for Aircraft, Heated Surface Type, General Specification for MIL-A-9482," USAF, 1954.

39. "New Anti-Icing System Announced," American Aviation, Vol.17, March 1954.

40. "New Boots and Alcohol System for Cessna," Flight, Vol.41, pp. 92-95, June 1954.

41. "New Methods of De-Icing for Wings and Tailplanes," Interavia, Vol. 5, pp. 644-646, December 1950.

42. "New Thermal De-Icer for Thin-Wing Jets," American Aviation, Vol. 15,November 1951.

43. "Novel De-Icing System," Air Pictorial and Air Reserve Gazette, Vol. 16,May 1954.

44. "Porous Panel Anti-Icing System," Aviation Week, Vol. 54, pp. 35-36,January 1951.

45. "Selected Bibliography of NACA-NASA Aircraft Icing Publications," NASATN-81651, 1981.

46. "Shedding Ice," Airports and Air Transportation, Vol. 5, March 1950.

47. "Study of Airfoil Anti-Icing System Temperature Variations DC-6," United Air Lines Report No.F-240, July 24, 1950.

48. "Study of High-Energy-Air Anti-Icing Systems for Flight Surfaces," WADCTR 54-35, October 1953.

49. "Study of Limited Type Ice Removal and Prevention Systems.Chemical Phase," Armour Research Foundation, WADC TR 55-261, June 1955.

50. "Study of Limited-Type Ice Removal and Prevention Systems.Mechanical Phase," Research Inc., WADC TR 55-262, April 1955.

51. "Study of Simplified Methods of Airfoil Heating," Beech Aircraft, TR57-587, June 1958.

52. "Study of the Means of Prevention or Removal of Ice from Aircraft Temperature Probes," Cook Research Laboratories, Final Rept.No.FPP 24-1, ASTIA AD-16809, May 1953.

53. "Surface Heaters Formed by Spraying Process," Engineering, Vol.177, pp. 378-379, March 1954.

54. "T.K.S.Aircraft De-Icing Equipment Manual," T.K.S.(Aircraft Deicing)Ltd., London.

55. "Thermal Anti-Icing Shields F-89," Aviation Week, Vol.59, August 1953.

56. "Thermal Anti-Icing Tests - DC-6," Report No.F-81-14, United Air Lines,Inc., March 1947.

57. "Tubes, Pitot, Electrically Heated, Aircraft," MIL-T-5421B, Amendment 1,May 1978.

58. "Vickers-Viking Fluid De-Icing Trials 1950," Published by T.K.S.(Air-craft De-Icing) Limited, Drayton House, London, 1950.

59. "Wing Tip Heaters for Globemaster II," Aviation Week, Vol. 55, December 1951.

60. Ackley, S. F., Itagaki, K., and Frank, M., "An Evaluation of Passive De-Icing, Mechanical De-Icing, and Ice Detection," CRREL Internal Report No. 35, November 1973.

61. Albright, A. E., "Experimental and Analytical Investigation of a Freezing Point Depressant Fluid Ice Protection System," NASA CR-174758, 1984.

62. Albright, A. E., "An Improved Method of Predicting Anti-Icing Flow Rates for a Fluid Ice Protection System," AIAA Paper 84-0023, 1984.

63. Albright, A. E., "A Summary of NASA's Research on the Fluid Ice Protection System," AIAA Paper 85-0467.

64. Albright, A. E., "Experimental and Analytical Investigation of a Freezing Point Depressant Fluid Ice Protection System," NASA CR-174758, January 1, 1984.

65. Albright, A., "A Summary of NASA's Research on the Fluid Ice Protection System," Paper No. AIAA-85-0467, AIAA 23rd Aerospace Sciences Meeting, Reno, Nevada, January 1985.

66. Anders, K., "Prevention of Ice Formation During Aerial Warfare," Der Deutsche Sport flieger, January 1941.

67. Andrus, C. G., "The Problem of Combating Ice-Accumulation," Aviation, April 1928.

68. Beaird, H. G., "Totally Anti-Icing the Business Jet," Soc. of Exp. Test Pilots, Technical Review, Vol. 9, No. 2, pp. 169-172, 1968.

69. Beard, M. G. and North, D., "Airline Operator's Verdict: Thermal De-Icing is Here to Stay," SAE Journal, Vol. 58, pp. 56-60, Discussion, pp. 60-61, May 1950.

70. Berner and Greiger, "What is an Optimum Anti-Icing Design?," The GlennL.Martin Company, Paper No. 48-SA-38, 1948.

71. Bernhart, W. D. and Zumwalt, G. W., "Electro-Impulse Deicing: Structural Dynamic Studies, Icing Tunnel Tests and Applications," AIAA Paper 84-0022, 1984.

72. Blackwell, R. I. and Lennox, J. W., "Controlled Porosity is Utilized for Fluid Distribution in Aircraft De-Icers: Application of Powder Metallurgy," Precision Metal Molding, Vol. 9, pp. 28-31, November 1951.

73. Blaha, B. J. and Evanich, P. L., "Pneumatic Boot for Helicopter Rotor De-Icing," NASA CP-2170, November 1980.

74. Bodrik, A. G. and Pavlov, V. A., "The Problem of Protecting Flight Vehicles from Icing," Vychislitel'naia i Prikladnaia Matematika, No. 12, pp. 138-141, 1970.(In Russian.)

75. Boelke, F. L. and Paselk, R. A., "Icing Problems and the Thermal Anti-Icing Systems," Journal of the Aeronautical Sciences, Vol.13, pp.485-497, September 1946.

76. Bowden, D. T., "Investigation of Porous Gas-Heated Leading-Edge Section for Icing Protection of a Delta Wing," NACA TN E54103, 1955.

77. Bowden, D. T., Gensemer, A. E., and Skeen, C. A., "Engineering Summary of Airframe Icing Technical Data," FAA Technical Report ADS-4, AD-608-865, 1964.

78. Bowler, E. H. and Wright, G. M., "Automatic Controllers for Aircraft Ice Protection Systems," NAE Report LR-67, July 3, 1953.

79. Breeze, R, K. and Conway, J., "A Preliminary Analysis of the Performance of the Anti-Icing and Rain Removal System of the AF Model F-107A Airplane as Powered by a Pratt and Whitney J75 Engine," North American Aviation Report NA 54-297-3, November 1955.

80. Brown, E. N., "Ice Detector Evaluation for Aircraft Hazard Warning," AIAA-82-4273, November 1982.

81. Brun, E., Caron, R., and Petit, M., "Thermal Anti-Icing," French Nat.Aviation Congress, Subsection No. 42, Physics of the Atmosphere, Icing Rept. No. 42-136, 1946, Translation, North American Aviation, Inc., January 1944.

82. Budenholzer, A., Fieldhouse, I. B., Waterman, T. E., and Yampolsky, J., "Study of High-Energy-Air Anti-Icing Systems for Flight Surfaces," WADC TR 54-35, October 1953.

83. Budenholzer, R. A., et al, "Study of Limited Type Ice Removal and Prevention Systems - Chemical Phase," WADC TR 55-261, AD-118-662/6, June 1, 1955.

84. Cansdale, J. T., "Helicopter Rotor Ice Accretion and Protection Research," The Sixth European Rotorcraft and Powered Lift Aircraft Forum, September 16-19, 1980, Vertica, Vol. 5, No. 4, pp. 357-368, 1981.

85. Chandler, Jr. H.C., "Survey of Aircraft Anti-Icing Equipment," NACA, ACR,February 1942.

86. Chao, David F., "Numerical Simulation of two-Dimensional Heat Transfer in Composite Bodies With Application to De-Icing of Aircraft Components," NASA CR-168283, November 1983.

87. Christenson, C. M., "Aircraft Icing Revelations Lighten Trying Tasks of Designer and Pilot," SAE, Journal, 54, pp. 103-204, October 1946.

88. Clay, W. C., "Ice Prevention on Aircraft by Means of Impregnated Leather Covers," NACA ACR, August 1935.

89. Cleeves, V., Schur, O., and Hauger, H., "Flight Test of Hot Air Thermal Anti-Icing System," Douglas Aircraft Co., Rept.SM-11952, XC-112, September 1946.

90. Dowdrey, L., et al, "Aircraft Ice Protection Conference 1961," Luton, G. B., D. Napier and Son, Ltd., 1961.

91. Cozby, D. E., "Effects of Recent Engine Developments on Boeing Aircraft Ice Protection Requirements," Symposium on Electro-Impulse De-Icing System at NASA Lewis Research Center, 13 June 1985.

92. Dahm, T. M. and Holloway, R. A., "Evaluation of Designs for Intermittently Heated Surfaces," Application and Industry, No. 14, Sept. 1954, AIEE Trans., Vol. 73, Pt. 2.

93. Datnov, A. G., "Icing of Aircraft on the Ground and Combating It," (Translation) Voyenizdat, 1962.

94. Dethman, I. H. and Devlin, Jr., J. J., "Evaluation of the Surface Anti-Icing System as Installed on F-89D Type Aircraft," WPAFB, TN WCT-53-53, ASTIA AD-23-33, November 1953.

95. Dornbrand, H. and Poggie, J. J., "Infra-Red Defrosting and De-Icing Progress Rept. No. 3," Republic Aviation Corporation, ERF-60. April 1951.

96. Dornbrand, H., "Infrared Defrosting and De-Icing," AF Technical Report 5874, January 1952.

97. Droege, W. C., "Instrumentation for Flight Testing of Thermal Anti-Icing Systems," Trans. ASME, August 1947.

98. Dunbar, R. M., "Installation of a Cyclic De-Icing Kit and Additional Instrumentation on F-86D Aircraft," AF No. 50458," AIRL TN 544, April 1954.

99. Flack, D. C., "Electricity in Aircraft.Part 5 - Methods of De-Icing,"Electrical Journal, Vol. 152, pp. 432-437, February 1954.

100. Forester, G. O and Lloyd, K. F., "Methods of Ice Detection and Protection on Modern Aircraft," World Aerospace Systems, Vol.1, pp.86-88, February 1965, Journal of the Society of Licensed Aircraft Engineers and Technologists, Vol. 3, pp. 20-22, July 1965.

101. Fraser, D., "Note on the Flight Testing and Assessment of Icing Protection Systems," NRC Report LR-5O, March 1953.

102. Fraser, D., Pettit, K. G., and Bowler, E. H., "Criteria for the Design, Assessment and Control of Icing Protection Systems," Aeronautical Engineering Review, Vol. 11, No. 7, July 1952.

103. Geer, W. C. and Scott, M., "The Prevention of the Ice Hazard on Airplanes," NACA TN 345, 1930.

104. Gelder, T. F., Lewis, J. P., and Koutz, S. L., "Icing Protection for a Turbojet Transport Airplane: Heating Requirements, Methods of Protection and Performance Penalties," NACA TN 2866, January 1953.

105. GDwan, W. H. and Mulholland, D. R., "Effectiveness of Thermal-Pneumatic Airfoil-Ice-Protection System," NACA RM E50K10a, 1951.

106. Gray, V. H. and Bowden, D. T., "Comparison of Several Methods of Cyclic De-Icing of a Gas Heated Airfoil," NACA RM E53C27, June 1953.

107. Gray, V. H. and Von Glahn, U. H., "NACA Heat Requirements for Ice Protection of a Cyclically Gas-Heated 36 Degree Swept Airfoil with Partial-Span Leading-Edge Slat," NACA Research Memo E56B23, CR-5903.

108. Gray, V. H., Bowden, D. T., and Von Glahn, U. H., "Preliminary Results of Cyclical De-Icing of a Gas-Heated Airfoil," NACA RM E51J29, 1952.

109. Greenly, K. H., "Recent Developments in Aircraft Ice Protection," Air-craft Engineering, Vol. 35, pp. 92-96, April 1963.

110. Guibert, A. G., "Thermal Anti-Icing Survey on Mt. Washington," Transactions of the ASME, Vol. 69, No. 8, 1947.

111. Hacker, P. T., et al, "Ice Protection for Turbojet Airplane.I-Meteorology and Physics of Icing.II-Determination of Heat Requirements.III-Thermal Anti-Icing Systems for High Speed Aircraft," Institute of Aeronautical Sciences, Special Publication No. FF-1, 1950.

112. Hackler, L. and Rissmiller, R., "Fluid Ice Protection Systems," FAA Technical Note DOT/FAA/CT-TN 86/11, July 1986.

113. Hansman, R. J., et al, "Microwave Ice Prevention," N82-26203, June 1,1982.

114. Hardy, J. K., "Protection of Aircraft Against Ice," Rep. No. S.M.E. 3380,British R.A.E., July 1946.

115. Hardy, J. K , "Protection of Aircraft Against Ice," IRAS, Vol. 51, No. 435, 1947.

116. Harper, T. W., "The Design and Use of Aircraft De-Icing Mats," World Aerospace Systems, Vol. 3, Paper 30, January 1967.

117. Hauger, H. H., "Intermittent Heating of Airfoil for Ice Protection,Utilizing Hot Air," Transactions of the ASME, Vol. 76, No. 2, 1954.

118. Hay, J. A., "Electrical and Hot Gas-Thermal Ice Protection," Aircraft Ice Protection Conference, 1958.

119. Hicks, J. R., "Improving Visibility During Periods of Supercooled Fog,"CRREL-TR-181, AD-648-484, December 1966.

120. Hillendahl, W. H., "Analysis of a Thermal Ice-Prevention System for Wing Leading-Edge Landing-Light Installation," NACA ARR No.4A11, 1944.

121. Hillendahl, W. H., "Tests of a Thermal Ice-Prevention System for a Wing Leading-Edge Landing-Light Installation," NACA WR-A-3, Dec. 1, 1944.

122. Howell, W. E., "A System for the Protection of Pitot Tube Pressure Lines From Ice," Harvard-Mt. Washington Icing Research Report 1946-1947, U. S.Air Materiel Command, Tech. Rept. No. 5676.

123. Hudson, V., "Flight Simulator Program Description of Anti-Icing Systems YF-102 and F-102A Airplanes," ASTIA AD-16572, June 1953.

124. Jackson, B., "De-Icing and Anti-Icing Installations," Canadian Aviation,Vol. 26, pp. 26-27, January 1953.

125. Jacob, M., et al, "Defrosting and Ice Prevention," Illinois Inst. of Technology, USAF Cont. No. W33-038 AC16808, Summary and Final Reports, 1948, 1949.

126. Joiner, D. L. and Heirich, C. J., "Flight Tests of the Complete Goodrich Electro-Thermal De-Icing Boot on the F-94, with Appendix," Lockheed Aircraft Corp., Preliminary Flight Test Memorandum No. 1065, June 1951.

127. Jonas, J., "F-89 Heat Anti-Icing Performance: Wing and Complete Airplane," Northrop Aircraft, Inc., Rept. No. A68-I, March 1947, Revised November 1949.

128. Jones, A. R. and Rodert, L. A., "Development of Thermal Ice-Prevention Equipment for the B-24D Airplane," NACA Wartime Report A-35, February 1943.

129. Jones, A. R. and Rodert, L. A., "Development of Thermal Ice-Prevention Equipment for the B-17F Airplane," NACA ARR No.3H24, 1943.

130. Jones, A. R. and Schlaff, B. A., "An Investigation of a Thermal Ice-Prevention System for a C-46 Cargo Airplane.VII.-Effect of the Thermal System on the Wing Structure Stresses as Established in Flight," NACA WR w-95, 1945.

131. Jones, A. R. and Spies, Jr., R. J., "An Investigation of a Thermal Ice-Prevention System for a C-46 Cargo Airplane. III-Description of Thermal Ice-Prevention Equipment for Wings, Empennage, and Windshield," NACA ARR No. 5A03b, 1945.

132. Jones, A. R., "An Investigation of a Thermal Ice Prevention System for a Twin-Engine Transport Airplane," NACA Report No.862, 1946.

133. Jongeneel, J. H. (editor), "A Symposium of Heat Anti-Icing," June 1946.

134. Karlsen, L. K. and Salberg, A., "Digital Simulation of Aircraft Longitudinal Motions Mth Tailplane Ice," KTH Aero Report 55, Dept. of Aeronautics, The Royal Institute of Technology, Stockholm, Sweden, 1983.

135. Keith, Jr., T. G., Dewitt, K. J., Masiulaniec, K. C., and Chao, D., "Predicted Electrothermal Deicing of Aircraft Blades," AIAA Paper 84-0110, 1984.

136. Knoernschild, E. M. and Larson, L. V., "Defrosting of High Performance Fighter Aircraft," AF Technical Report No. 6118, December 1950.

137. Kohlman, D. L., et al, "A Method of Predicting Flow Rates Required to Achieve Anti-Icing Performance With a Porous Leading Edge Ice Protection System," NASA CR-16213, N83-32782, Aug. 1, 1983.

138. Kohlman, D. L., et al, "Icing Tunnel Tests of a Clycol-Exuding Porous Leading Edge Ice Protection System on a General Aviation Airfoil," (AIAA 81-0405), NASA CR-165444, N82-10021/5, Sept. 1, 1981.

139. Kohlman, D. L., Schweikhard, W. G., Albright, A. E., and Evanich, P., "Icing Tunnel Tests of a Glycol-Exuding Porous Leading Edge Ice Protection System on a General Aviation Airfoil," NASA CR-164377, KU-FRL-464-1, May 1981.

140. Kordinov, V. K., Lenntev, V. N., Savin, V. S., Stroganov, B. A., Tenishev, R. Th., and Teslenko, A. I., "Aircraft Deicing Systems - Design Fundamentals and Test Methods," Moscow, Izdatel'stvo Mashintroenie.(In Russian.)

141. Korsakova, I. S., Akimov, S. V., and Nikitina, E. A., "Rapid Laboratory Determination of Effectiveness of Anti-Icing Additives," Chem.Technol.Fuels Oils, Vol. 15, No. 7-8, pp. 617-619, July-August 1979.

142. Kronenberger, "Lockheed Advanced Ice Protection System Test, Letter Report," USAAEFA-75-26/76-04, March 1976.

143. Kohring, M. S., "Investigation of the Possibility of Preventing Ice Formation on Wings and Propellers of Aircraft by the Utilization of Exhaust Gas," NRC Report PAE-19 (also MD-1), May 1935.

144. Lacey, Jr., J. J. "Turbine Engine Icing and Ice Detection," ASME Paper72-GT-6 for Meeting March 26-30, 1972.

145. Lake, H. G., "An Investigation of the Problem of Ice Removal from B-29 Radomes," WADC-TR-52-46, AD-A075-868/0, January 1952.

146. Larson. R. W., "Evaluation of the Wing and Empennage 600,000/BTU Anti-Icing Heater Installation for the C-124 Type Airplane.Vols. I and II," Douglas Aircraft, Testing Division, Rept. No. DEV.-1020, February 1953.

147. Lavedev, N. V., "Prevention of Icing of Aircraft," (Translation) Oborongiz, 1939.

148. Leckman, P. R., "Qualification of Light Aircraft for Flight in Icing Conditions," SAE 710394, March 1971.

149. Leffel, Kevin L., "A Numerical and Experimental Investigation of Electro-thermal Aircraft De-Icing," NASA CR-175024, Prepared for Lewis Research Center Under Grant NAG 3-72, January 1986.

150. Levin, I. A., "USSR Electric Impulse De-Icing System Design," Aircraft Eng. Vol. 44, No. 7, pp. 7-10, July 1972.

151. Lewis, G. J., "The Electrodynamic Operation of Electro-Impulse De-Icing Systems," AIAA-86-0547, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

152. Lewis, J. P. and Bowden, D. T., "Preliminary Investigation of Cyclic De-Icing of an Airfoil Using an External Electric Heater," NACA RM E51J30, 1952.

153. Lewis, J. P. and Bowden, D. T., "Experimental Investigations of Cyclic De-Icing of an Airfoil Using External Electric Heater," NACA RM E521J30, June 1953.

154. Lewis, W., "Review of Icing Criteria in Aircraft Ice Protection," Report of Symposium of April 28-30, 1969, DOT/FAA Flight Standards Service, Washington, D. C., 1969.

155. Long, T., "Icing Protection and Compartment Heating, Parasite RF-84F Airplane," Rept. No. S.O.M. F-5130, ASTIA AD-11276, November 1952.

156. Look, B. C., "Flight Tests of the Thermal Ice-Prevention Equipment on the B-17F Airplane," NACA A.R.R.No.4B02, 1944.

157. Loughborough, D. L., Green, H. E., and Roush, P. A., "A Study of Wing De-Icer Performance on Mount Washington," Aero. Eng. Rev., Vol. 7, No. 9, pp. 41-50, September 1948.

158. Mahon, B. E., "Thermal Anti-Icing System Temperatures - Model 377 Airplane," Tests 85-1, 86-7, 88-1, and 93-1, Boeing Aircraft Company, August 16, 1948.

159. Marinelli, J. L., "Evaluation of L-23F De-Icing and Anti-Icing Systems,"ATBG-ACAVN 1861.1/62, AD-276-277/1, May 2, 1962.

160. Maxin, I. P., "Methods of Evaluating the Efficiency of Aircraft Thermal Anti-Icers as Related to Water Content and Temperature of Clouds," Trudy TSAO, No. 39, 1962.

161. McBaine, C. K., "Weight Comparison of De-Icing Systems," Aero Digest,Vol. 63, September 1951.

162. McDonald, J. A. and Rigney, Jr., B. L., "Test Evalaution of External Air Blast Airfoil Anti-Icing Method," ASD-TR55148, March 1955.

163. McDonald, J. A. and Rigney, Jr., B. L., "Test Evalaution of External Air Blast Airfoil Anti-Icing Method," WADC Report 55-148, March 1955.

164. Messinger, B. L. and Rich, B. R., "Cyclic Electro-Thermal De-Icing for the F-94C and Appendix," Lockheed Aircraft Corp., Rept.No.7853, ASTIA AD-4 950, February 1951.

165. Messinger, B. L. and Werner, S. B., "Design and Development of the Ice Protection Systems for the Lockheed Electra," Aircraft Ice Protection Conference, 1959, D.Napier and Son, Ltd.

166. Messinger, B. L., "Ice Prevention as Related to Airframe Design," SAE,National Aeronautical Meeting, Los Angeles, 1952, Lockheed, 1952.

167. Miller, O.D., "Flight Tests Results of the Goodrich High Pressure Pneumatic De-Icers," Tech.Note WCT-54-48, Wright Air Dev.Center, Wright-Patterson Air Force Base, July 1954.

168. Mkhitaryan, A. M., Maximov, V. S., Selen'ko, A. V., and Prusov, V. A., "Experimental Study of a Hot-Air Jet Anti-Icing System," Fluid Mech.,Sov. Res., Vol. 2, No. 6, pp. 144-150, November-December 1973.

169. Moroshkin, M. Ya., Smolin, V. N., Skobel'tsyn, Yu. A., and Komlev, A. F., "Selection of Spray Nozzle and Its Operating Regimes for Removing Ice Deposits, Frost, and Frozen-On Snow from Airplane Surfaces," Sov.Aeronaut., Vol. 20, No. 1, pp. 111-113, 1977.

170. Mueller, A. A., Ellis, D. R., and Bassett, D. C., "Flight Evaluation of an Electro-Impulse De-Icing System on a Light General Aviation Airplane," AIAA/AHS/ASEE Aircraft Design Systems and Operation Meeting, San Diego, CA, October 31-November 2, 1984, AIAA Paper No.84-2495.

171. Naiman, J. M., "Basic Principles Used in the Design of the Thermal Anti-Icing System of the DC-6 Airfoils," Douglas Aircraft Co., Rept. No.Sm-11911, 1946.

172. Naiman, J. M., "A New Method for Determining the Inside Air Flow Distribution for the Thermal Anti-Icing of an Airfoil Surface," McDonnell Douglas Corporation Icing Reports, April 11, 1946.

173. Neel, C. B.and Jones, A. R., "Flight Tests of Thermal Ice-Prevention Equipment in the XB-24F Airplane," NACA Wartime Report A-7, October 1943.

174. Neel, C. B., "A Procedure for the Design of Air-Heated Ice-Prevention Systems," NACA TN 3130, June 1954.

175. Neel, Jr., C. B., "An Investigation of a Thermal Ice-Prevention System for a C-46 Cargo Airplane.I-Analysis of the Thermal Design for Wings, Empennage and Windshield," NACA Wartime Report A-52, February 1945.

176. Neel, Jr., C. B., "The Design of Air-Heated Thermal Ice-Prevention Systems," Presented at the Airplane Icing Information Course at the University of Michigan, March 20-April 3, 1953.

177. Nelepovitz, D. O. and Rosenthal, H. A., "Electro-Impulse De-Icing of Aircraft Engine Inlets," AIAA-86-0546, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

178. Newbigin, H. G., "Development of the Ambassador De-Icing System; An Account of a Series of Experiments Leading to a Satisfactory Installation," Aircraft Engineering, Vol. 24, No. 282, August 1952.

179. Newman, R. L., "Flight Testing a Liquid Ice Protection System on a Single-Engine Airplane," SAE Technical Paper No. 850923, April 1985.

180. Newton, D. W., "Integrated Approach to the Problem of Aircraft Icing,"J. Aircr., Vol. 15, No. 6, pp. 374-380, June 1978.

181 North, D,, "Heat Anti-Icing for the Airlines," Paper 48SA-40, ASME, 1948.

182. Orr, J. L. and Stapells, R. J., "A Summary of Replies to the National Research Council Questionnaire on Aircraft De-Icing," Nat.Res.Council, Canada, Rept.No.MD-24, October 1942.

183. Orr, J. L., "Electro-Thermal De-Icing Systems - Their Design and Control ," Airplane Icing Formation Course, University of Michigan, Ann Arbor, April 1, 1953.

184. Orr, J. L., "Electro-Thermal De-Icing Systems," Low Temperature Laboratory, Ottawa, Canada, Lecture No. 8, University of Michigan.

185. Orr, J. L., et al, "Thermal De-Icing," Paris, Docarero, No.29, AD-127-343, September 1954.

186. Orr, J. L., Fraser, D., and Milsum, J. H., "Aircraft De-Icing by Thermal Methods," Fourth Anglo-American Aeronautical Conference, London, England, August 1953.

187. Orr, J. L., Fraser, D., Lynch, J. A., and Rush, C. K., "Electro-Thermal Methods of Protecting Aircraft Against Ice Formation," NRC Report MD-34, July 1950.

188. Orr, J. L., Milsum, J. H., and Rush, C. K., "Electro-Thermal De-Icing Systems: Their Design and Control ," NRC Report LR-7O, March 1953.

189. Page, A. E. V., "Aircraft Systems and Equipment," Aircraft Engineering,Vol. 39, pp. 38-41, September 1967.

190. Pall, D. B., "Porous Metals in Aircraft," Aero. Engr. Rev., Vol. 13, pp. 36-41, September 1967.

191. Palmer, R. J., "Palmer Airfoil De-Icer Equipment," Prospectus of the Palmer Company, London, 1965.

192. Palmer, R. J., "Icephobic Plastic Materials," Report Serial No. LR-AD-2O57, Materials Research and Process Engineering, May 4, 1964.

193. Perkins, Porter, "Coping with In-Flight Icing," Sverdrup Technology, Inc., presented at 29th Corporate Aviation Seminar, Montreal, Canada, April 1-3, 1984.

194. Pettit, K. G., Lynch, J. A., Ainley, W., and Orr, J. L., "Interim Report on Flight Tests of Electro-Thermal Wing De-Icing," Nat.Res.Council, Canada, NRC Report, (unpublished), August 1948.

195. Pring-Rowe, M., "Porous Metal for Fluid Airframe De-Icer Distributors, Summary of Development Work and Test Reports," Res.Air.No.2547, Ministry of Aircraft Production, Millbank, London.

196. Rodert, L. A. and Jackson, R., "Preliminary Investigation and Design of an Air-Heated Mng for Lockheed 12-A Airplane," NACA Wartime Report A-34, A.R.R., April 1942.

197. Rodert, L. A. and Jackson, R., "A Description of the JU-88 Airplane Anti-Icing Equipment," NACA Wartime Report A-39, September 1942.

198. Rodert, L. A. and Jones, A. R., "A Flight Investigation of Exhaust-Heat De-Icing," NACA TN 783, 1940.

199. Rodert, L. A., "A Preliminary Study of the Prevention of Ice on Aircraft by the Use of Engine-Exhaust Heat," NACA TN 712, June 1939.

200. Rodert, L. A., "Thermal Ice Prevention For Aircraft - Some Suggested Specifications," ASME Aviation Meeting, June 5, 1946.

201. Rodert, L. A., Clowsing, L. A., and McAvoy, W. H., "Recent Flight Research on Ice Prevention," NACA A.R.R., Jan.1942.

202. Rodert, L. A., McAvoy, W. H., and Clousing, L. A., "Preliminary Report on Flight Tests of an Airplane Having Exhaust-Heated Wings," NACA Confidential Report, 1941.

203. Roper, R. A., "Aircraft Electrical Ice Protection and Future Developments," Aircraft Ice Protection Conference, 1962.

204. Ross, R. and Stone, J. G., "Wing Leading Edge Anti-Icing Analysis - Final Report," RAA 81-2, Ross Aviation Associates, Sedgwick, Kansas, March 1981.

205. Ross, R. and Stone, J. G., "Gates Learjet Model 55 Wing Leading Edge Anti-Icing Analysis," Report RAA 81-2, Ross Aviation Associates, Sedgwick, Kansas, March 1981.

206. Ross, R., "Model 55 Wing Leading Edge Anti-Icing Analysis," RAA-80-7,Dec.1, 1980.

207. Ross, R., "Analysis of an Airplane Windshield Anti-Icing System Using Hot Air," Journal of Aircraft, Vol.20, No.11, November 1983.

208. Rudolph, J. D., "Windshield Anti-Icing System Tests and Icing Investigation of Additional Components F-86D Airplane," NAA Model NA-165, NA-51-961, ATIA AD 36003, 1950-51 Icing Season, Project Summit - Mt.Washington, May 10, 1952.

209. Ruggeri, R. S., "De-Icing and Runback Characteristics of Three Cyclic Electric, External De-Icing Boots Employing Chordwise Shedding," NACA RM E53C26, 1953.

210. Savin, V. S., "Aircraft Anti-Icing System - Principles of Design and Test Methods," (Translation) Army Foreign Science and Technology Center, Washington, D.C., 1967.

211. Savin, V. S., Tenishev, R. Kh., Stroganov, B. A., Kordinov, V. K., and Teslenko, A. I., "Aircraft Anti-Icing System: Principles of Design and Test Methods," FSTC-HT-23-411-69, AD-719-922, January 26, 1971.

212. Schaefer, V. J., "Heat Requirements for Instruments and Airfoils During Icing Storms on Mt.Washington," Basic Icing Research by General Electric Co., Fiscal Year 1946, U. S.Air Forces, Tech. Rept. 5539, 1947.

213. Scherrer, R., "Flight Tests of Thermal-Ice Prevention Equipment on a Lockheed 12A Airplane," NACA Wartime Report A-49, November 1943.

214. Schlaff, B. A. and Selna, J., "An Investigation of a Thermal Ice-Prevention System for a Cargo Airplane.IX - The Temperature of the Wing Leading-Edge Structure as Established in Flight," NACA TN 1599, June 1948.

215. Schrag, R. L. and Zumwalt, G. W., "Electro-Impulse De-Icing: Concept and Electrodynamic Studies," AIAA 22nd Aerospace Sciences Meeting, Reno, NV, Paper No. 84-0021, January 9-12, 1984.

216. Selna, J., "An Investigation of a Thermal Ice-Prevention System for a c-46 Cargo Airplane. V. - Effect of Thermal System on Airplane Cruise Performance," NACA Wartime Report A-9, May 1945.(Also NACA ARR No.5D06, 1945.)

217. Selna, J., Neel, Jr., C. B., and Zeiller, E. L., "An Investigation of a Thermal Ice-Prevention System for a C-46 Cargo Airplane.IV.- Results of Flight Tests on Dry-Air and Natural Icing Conditions," NACA A.R.R.No.5A03c, 1945.

218. Smith-Johannsen, R., "The "Peel Off" Mechanical Wing De-Icer," Basic Icing Research by General Electric Co., Fiscal Year 1946, U.S.Air Forces, Tech.Rept.5539, 1947.

219. Smith, A. G.and Jones, C., "Anti-Icing and Boundary Layer Control by Slit Blowing," Aircraft Icing Protection Conference, 1961.

220. Smith, D. K. and Hatcher, F. A., "The Ground De-Icing of Aircraft," Society of Licensed Aircraft Engineers and Technologists Journal, Vol. 1, No. 2, pp. 5-8, 1963.

221. Smith, L. D., "Anti-Icing Today's Business Jets," SAE Paper 690333 for Meeting March 26-28, 1969.

222. Sogin, H. H., "A Design Manual for Thermal Anti-Icing Systems," WADC Technical Report 54-313, Illinois Institute of Technology, 1 September 1954.

223. Stearns, B. D. and Dwyer, G. T., "An Evaluation of the C-133 Wing De-Icing System," Wright Air Development Center.

224. Swert, David, "Pneumatic Impulse Ice Protection System," Private Communication for the B.F. Goodrich Company to Gates Learjet Corporation, April 14, 1987.

225. Tanner, D. C., "Fluid De-Icing," Aircraft Ice Protection Conference,1961.

226. Tenishev, R. Kh., Stroganov, B. A., Savin, V. S., Kordinov, V. K., and Teslenko, A.I., "De-Icing Systems of Flight Vehicles.Bases of Design Methods for Testing.Part 1," FTO-1D(RS)T-1163-79-PT-1, AD-A090-980/4, September 7, 1979.

227. Tenishev, R. Kh., Stroganov, B. A., Savin, V. S., Kordinov, V. K., and Teslenko, AI., "De-Icing Systems of Flight Vehicles.Bases of Design Methods for Testing.Part 2," FTD-ID(RS)T-1163-79-PT-2, AD-A090-981/2, September 7, 1979.

228. Thielman, N. W., "Wing De-Icer Timer, Type Tests-Model F-94C," Lockheed Aircraft Corp., Report No.5196.

229. Thompson, J. K., "Considerations Regarding Requirements for Wing and Empennage Ice Protection Systems on High Performance Aircraft," FAA Memorandum Report, June 1962.

230. Tribus, M. and Tessman, J. R., "Report on the Development and Application of Heated Wings," AAF TR 4972, Add. I., January 1946.(Available from Office of Technical Services, U.S.Department of Commerce as PB No.18122.)

231. Tribus, M., "Development and Application of Heated Wings," SAE Journal,June 1946.

232. Tribus, M., "Intermittent Heating for Protection in Aircraft Icing,"Transactions of the A.S.M.E., Vol. 73, No. 8, November 1951.

233. Tribus, M., "Work Report for June 1952 WADC, USAF on Research in the Design of Basic De-Icing Apparatus," Proj.M992, Univ.of Michigan Engineering Research Institute.

234. Tribus, M., "A Review of Some German Developments in Airplane Anti-Icing," SME Heat Transfer Div., Annual Meeting, New York, 1946.

235. Trunov, O. K. and Egorov, M. S., "Some Results of Experimental Flights in Natural Icing Conditions and Operation of Aircraft Thermal Ice-Protection Systems," (Translation) National Research Inst.for Civil Air Fleet, USSR, 1957.

236. Trunov, O. K. and Tenishev, R. H., "Some Problems of Aircraft and Heli-copter Ice Protection," Aircraft Ice Protection Conference, 1961.

237. Trunov, O. K., "Some Results of Experimental Flights in Natural Icing Conditions and Operation of Aircraft Thermal Ice Protection Systems," Paper Presented at the International Ice Protection Conference, D. Napier and Son, Ltd., May 1960.

238. Trunov, O. K., "Icing of Aircraft and the Means of Preventing It," FTD-MT-65-490, August 1957.

239. Trunov, O. K., "Icing of Aircraft and Means of Combatting It," FTD-ID-(RS)T-1162-79, AD-A087-867, Sept.5, 1979.

240. Vaughan, J. R. and Hile, E., "B-36 Jet Pod De-Icing and Anti-Icing Tests at Eglin Air Force Base, Florida," Consolidated Vultee Aircraft Corp., Rept. No. F Za-36-274, October 1952.

241. Weighardt, K., "Hot-Air Discharge for De-Icing," AAF Translation, Hq. Air Materiel Command, December 1946.

242. Weiner, F. R., "An Investigation of Intermittent Heating for Aircraft Ice Protection," Master's Thesis, UCLA, December 1950.

243. Weiner, F., "Further Remarks on Intermittent Heating for Aircraft Ice Protection," Trans. of the ASME, Vol. 73, No. 8, 1951.

244. Werner, J. B., "Computation Techniques for Use in Studying Hot Air Cycle De-Icing Systems and Appendices I through III," North American Aviation, Inc., Rept. No. NA-51-788.

245. [illegible]nowski, J., "Snow Removal and De-Icing of Transport Aircraft," Technika Lotnicza i Astronautyczna, Vol. 25, pp. 28-33. (In Polish.)

246. Zumwalt, G. W. and Friedberg, R. A., "Designing an Electro-Impulse De-Icing System," AIAA-86-0545, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

247. Zumwalt, G. W. and Mueller, A. A., "Flight and Wind Tunnel Tests of an Electro-Impulse De-Icing Systems," AIAA Paper 85-2234, 1985.

248. Zumwalt, G. W., Schrag, R. L., Bernhart, W. D., and Friedberg, R. A., "Analysis and Tests for Design for an Electro-Impulse De-Icing System," NASA CR-174919, May 1985.

249. Zumwalt, G. W. "Icing Tunnel Tests of Electro-Impulse De-Icing of an Engine Inlet and High Speed Wing," AIAA Paper 85-0466, 1985.

250. Zumwalt, G. W., "Flight and Wind Tunnel Tests of an Electro-Impulse De-Icing on the Lear Fan Kevlar Composite Leading Edge," Aerospace Engineering Department, Wichita State University.

251. Zumwalt, G. W., "Electromagnetic Impulse De-Icing Applied to a Nacelle Nose Lip," AIAA/SAE/ASME 23rd Joint Propulsion Conference, Monterey, CA, July 8-10, 1985, AIAA Paper 85-1118.

252. Zumwalt, G. W., et al., "The Structural Dynam[illegible] Electro-Impulse De-Icing on the Lear Fan Kevlar Composite Leading Edge," SAE-8509[illegible] [illegible]ril 19, 1985.

CHAPTER VIII

SECTION 15.0

DROPLET TRAJECTORIES AND IMPINGEMENT

BIBLIOGRAPHY

VIII.15.0 DROPLET TRAJECTORIES AND IMPINGEMENT

1. "Ice Accretion Within the Convective Layer," Transcontinental and Western Air, Inc., Meteorological Dept., Tech.Note No.4, October 1961.

2. Abramson, A E. and Torgeson, W. L., "Calculation of Droplet Trajectories Using an Electronic Analog Computer," Proc. of the Third Midwestern Conference on Fluid Mechanics, University of Minnesota, 1953.

3. Beard, K. V. and Pruppacher, H. R., "A Determination of the Terminal Velocity and Drag of Small Water Drops by Means of a Wind Tunnel," Journal of Atmospheric Science, 1969, Vol. 26, No. 5, pp.1066-1072.

4. Bergrun, N. R., "An Empirically Derived Basis for Calculating Area, Rate and Distribution of Water-Drop Impingement on Airfoils," NACA Rep.1107, 1952.

5. Bergrun, N. R., "A Method for Numerically Calculating the Area and Distribution of Water Impingement on the Leading Edge of an Airfoil in a Cloud," NACA TN 1397, 1947.

6. Bergrun, N. R., "An Empirical Method Permitting Rapid Determination of the Area, Rate, and Distribution of Water-Drop Impingement on an Airfoil of Arbitrary Section at Subsonic Speeds," NACA TN 2476, 1951.

7. Bigg, F. J. and Bauchen, J. F., "Impingement of Water Droplets on Aero-foils," R.A.E. TN Mech. Eng. 208, 1955.

8. Bragg, M. B. and Gregorek, G. M., "An Incompressible Droplet Impingement Analysis of Thirty Low and Medium Speed Airfoils," NASA CR.

9. Bragg, M. B., "A Similarity Analysis of the Droplet Trajectory Equation,"AIAA 82-4285, AIAA Journal, Vol. 20, No. 12, December 1982.

10. Bragg, M. B., "Droplet Impingement Analysis of Two Propeller Spinners,"AARL TR 8403, August 1984.

11. Bragg, M. B., "The Effect of Compressibility on the Droplet Impingement Characteristics of Airfoils," Unpublished paper, Ohio State University.

12. Bragg, M. B., "A Similarity Analysis of the Droplet Trajectory Equation,"AIAA Journal, Vol. 20, No. 12, December 1982, pp. 1681-1686.

13. Bragg, M. B., "A Numerical Method for Predicting Droplet Impingement on Low-Speed Aircraft," NASA CR to be published, 1986.

14. Bragg, M. B., "Predicting Rime Ice Accretion on Airfoils," AIAA Journal, Vol. 23, No. 3, March 1985, pp. 381-386.

15. Bragg, M. B., "The Effect of Geometry on Airfoil Icing Characteristics,"AIAA Journal of Aircraft, Vol. 21, No. 7, July 1984, pp. 505-511.

16. Bragg, M. B., "Detailed Measurements of the Flow Field in the Vicinity of an Airfoil with Glaze Ice," AIAA Paper 85-0409, January 1985.

17. Breer, M. D. and Seibel, W., "Particle Trajectory Program-User Manual,"Boeing Document D3-9655-1, Revision B, December 1974

18. Brun, R. G., Gallagher, H. M., and Voght, D. E., "Impingement of Water Droplets on NACA 65A004 Airfoil at 8 Degree Angle of Attack," NACA TN 3155, 1954.

19. Brun, R. J., and Dorsch, R. G., "Variation of Local Liquid-Water Concentration about an Ellipsoid of Fineness Ratio 10 Moving in a Droplet Field," NACA TN 3410, 1955.

20. Brun, R. J. and Dorsch, R. G., "Impingement of Water Droplets on an Ellipsiod with Fineness Ratio 10 in Axisymmetric Flow," NACA TN 3147, May 1954.

21. Brun, R. J. and Mergler, H. W., "Impingement of Water Droplets on a Cylinder in an Incompressible Flow Field and Evaluation of Rotating Multi-Cylinder Method for Measurement of Droplet-Size Distribution, Volume Median Droplet Size, and Liquid Water Content in Clouds," NACA TN 2914, 1953.

22. Brun, R. J. and Vogt, D. E., "Impingement of Water Droplets on NACA65A004 Airfoil at 0 Degree Angle of Attack," NACA TN 3586, 1955.

23. Brun, R. J., and Vogt, D. E., "Impingement of Cloud Droplets on 36.5 Percent Thick Joukowski Airfoil at Zero Angle of Attack and Discussion of Use as Cloud Measuring Instrument in Dye Tracer Technique," NACA TN 4035, 1957.

24. Brun, R. J., Gallagher, H. M., and Vogt, D. E., "Impingement of Water Droplets on NACA 65A004 Airfoil and Effect of Change on Airfoil Thickness from 12 to 4 Percent at 4 Degree Angle of Attack," NACA TN 3047, 1953.

25. Brun, R. J., Gallagher, H. M., and Vogt, D. E., "Impingement of Water Droplets on NACA 651-208 and 651-212 Airfoils at 4 Degree Angle of Attack," NACA TN 2952, 1953.

26. Brun, R. J., Serafini, J. S., and Gallagher, H. M., "Impingement of Cloud Droplets on Aerodynamic Bodies as Affected by Compressibility of Air Flow Around the Body," NACA TN 2903, 1953.

27. Brun, R. J., Serafini, J. S., and Moshos, G. J., "Impingement of Water Droplets on an NACA 651-212 Airfoil at an Angle of Attack of 4 Degrees," NACA RM E52B12, 1952.

28. Brun, R. J., W. Lewis, W., Perkins, P. J., and Serafini, J. S., "Impingement of Cloud Droplets on a Cylinder and Procedure for Measuring Liquid-Water-Content and Droplet Sizes in Supercooled Clouds by Rotating Multi-Cylinder Method," NACA Rep. 1215, 1955.(Supersedes NACA TN's 2903, 2904, and NACA RM E53D23.)

29. Callaghan, E. E. and Serafini, J. S., "A Method for Rapid Determination of the Icing Limit of A Body in Terms of the Stream Conditions," NACA TN 2914, 1953.

30. Callaghan, E. E. and Serafini, J. S., "Analytical Investigation of Icing Limit for Diamond-Shaped Airfoil in Transonic and Supersonic Flow," NACA TN 2861, 1953.

31. Cansdale, J. T. and Gent, R. W., "Ice Accretion on Aerofoils in Two Dimensional Compressible Flow - A Theoretical Model," RAE TR 82128, January 1983.

32. Chang, H. P. and Kimble, K. R., "Influence of Multidroplet Size Distribution on Icing Collection Efficiency," Paper No.AIAA-83-0110, AIAA 21st Aerospace Sciences Meeting, Reno, Nevada, January 10-13, 1983.

33. Coles, W. D., "Icing Limits and Wet Surface Temperature Variation for Two Airfoil Shapes Under Simulated High-Speed Flight Conditions," NACA TN 3396, 1955.

34. Cosstephens, S. S. and Bragg, M. B., "Correlations for Airfoil Droplet Impingement Parameters," Aeronautical Research Laboratory, The Ohio State University, Report No.AARL TO 8401, April 1984.

35. Dorsch, R. G. and Brun, R. J., "A Method for Determining Cloud-Droplet Impingement on Swept Wings," NACA TN 2931, 1953.

36. Dorsch, R. G. and Brun, R. J., "Variation of Local Liquid Water Concentration about an Ellipsoid of Fineness Ratio 5 Moving in a Droplet Field," NACA TN 3153, 1954.

37. Dorsch, R. G. and Brun, R. J., "A Method for Determining Cloud-Droplet Impingement on Swept Wings," NACA TN 2931, 1953.

38. Dorsch, R. G. and Brun, R. J. and Gregg, J. L., "Impingement of Water Droplets on an Ellipsiod with Fineness Ratio 5 in Axisymmetric Flow," NACA TN 3099, March 1954.

39. Dorsch, R. G., Saper, P. G., and Kadow, C. F., "Impingement of Water Droplets on a Sphere," NACA TN 3587, November 1955.

40. Drell, H. and Valentine, P. J., "Comments on Methods of Calculating Water Catch and a Correlation of Some New Data," Lockheed Report 8552, April 1952.

41. Findeisen, W.and Walliser, B., "Experimental Evidence Supporting the Dependence of the Icing Limit Upon Flying Speed," U. S. Air Force Translation No.405, 1943.

42. Frost, W. Chang, H. P. and Kimble, K. R., "Particle Trajectory Computer Program for Icing Analysis," Final Report for NASA/Lewis Research Center under Contract NAS3-22448 by FWG Associates, Inc., April 1982.

43. Frost, W., Chang, H. P., Shieh, C-F., and Kimble, K. R., "Two-Dimensional Particle Trajectory Computer Program," Contract NAS3-22448, NASA Lewis Research Center, March 9, 1982.

44. Gelder, T. F., "Droplet Impingement and Ingestion by Supersonic Nose Inlet in Subsonic Tunnel Conditions," NACA TN 4268, 1958.

45. Gelder, T. F., Smyers, Jr., W. H., and Von Glahn, U. H., "Experimental Droplet Impingement on Several Two-Dimensional Airfoils with Thickness Ratios of 6 to 16 Percent," NACA TN 3839, Dec. 1956.

46. Gelder, T. F., Smyers, W. H., and Von Glahn, U. H., "A Dye-Tracer Technique for Experimentally Obtaining Impingement Characteristics of Arbitrary Bodies and a Method for Determining Droplet Size Distribution," NACA TN 3338, 1955.

47. Gent, R. W., "Calculation of Water Droplet Trajectories about an Aerofoil in Steady, Two-Dimensional, Compressible Flow," Technical Report No.84060, Royal Aircraft Establishment, June 1984.

48. Glauert, M., "A Method of Constructing the Path of Raindrops of Different Diameters Moving in the Neighorhood of (1) a Circular Cylinder; (2) an Aerofoil, Placed in a Uniform Stream of Air; and a Determination of the Rate of Deposit of the Drops on the Surface and the Percentage of Drop Caught," British A.R.C., R and M No. 2025, November 1940.

49. Goodman, T. R., "Linearized Theory of Water Drop Impingement," J.A.S.,Vol. 23, No. 4, 1956.

50. Gray, V. H., "Correlation of Airfoil Ice Formations and Their Aerodynamic Effects with Impingement and Flight Conditions," Presented at the SAE National Aeronautics Meeting, Sept. 30-Oct. 5, 1957, SAE Preprint No.225.

51. Gray, V. H., "Correlations Among Ice Measurements, Impingement Rates, Icing Conditions, and Drag Coefficients for an Unswept NACA 65A004 Airfoil ," NACA TN 4151, 1958.

52. Guibert, A. G., "Determination of the Rate, the Area, and the Distribution of Impingement of Water-Drops on Various Airfoils from Trajectories Obtained on the Differential Analyzer - Addendum I, Engr.Waterdrop Trajectory Research," University of California, Dept.of Engineering, Contract NAW-5677, April 1949.

53. Guibert, A. G., "Impingement of Waterdrops on Various Airfoils from Trajectories Obtained on the Differential Analyzer - Addendum I," Engineering Waterdrop Trajectory Research, University of California, Department of Engineering, April 1949.

54. Guibert, A. G., Janssen, E., and Robins, W. M., "Determination of Rate, Area and Distribution of Impingement of Water Drops on Various Airfoils from Trajectories Obtained on the Differential Analyzer," NACA RM 9A05, 1949.

55. Hacker, P. T., Brun, R. J., and Boyd, B., "Impingement of Droplets on 90Degree Elbows with Potential Flow," NACA TN 2999, 1953.

56. Hacker, P. T., Saper, P. J., and Kadow, C. F., "Impingement of Droplets on 60 Degree Elbows with Potential Flow," NACA TN 3770, 1956.

57. Hansman, Jr., R. J., "The Effect of the Atmospheric Droplet Size Distribution on Aircraft Ice Accretion," AIAA-84-0108, AIAA 22nd Aerospace Sciences Meeting, January 1984.

58. Hansman, Jr., R. J., "Droplet Size Distribution Effects on Aircraft Ice Accretion," Journal of Aircraft, Vol. 22, No. 6, June 1985.

59. Hofelt, C. and Batuik, G., "Droplet Interception Investigation Upon Various Airfoil Sections at Above Freezing Temperatures," DGAI Report No. 159, Daniel Guggenheim Airship Institute, June 1949.

60. Jenkins, D. C., "The Acceleration of Water Drops by an Airstream of Constant Relative Velocity," ARC CP. No. 539, 1961.

61. Jenkins, D. C., Booker, J. D., and Sweed, J. W., "An Experimental Method for the Study of the Impact Between a Liquid Drop and a Surface Moving at High Speed," Aeronautical Research Council, GB, HQSO, 1961.

62. Kim, J. J. and Elangovan, R., "An Efficient Numerical Computation Scheme for Stiff Equations of Droplet Trajectories," AIAA-86-0407, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

63. Kim, J. J., "Computational Particle Trajectory Analysis on a 3-Dimensional Engine Inlet," AIAA-85-0411, AIAA 23rd Aerospace Sciences Meeting, Reno, Nevada, January 14-17, 1985.Also Ph.D.Dissertation, Wichita State University.

64. Kim, J. J., "Particle Trajectory Computation on a 3-Dimensional Engine Inlet," NASA CR 175023, DOT-FAA-CT-86-1, Prepared for Lewis Research Center Under Grant NAG 3-566, January 1986.

65. Kloner, M.O., "A Method for Calculating Ice Catch on Airfoils and Inlets," LR 23373, Lockheed California Co., April 1970.

66. Langmuir, I., and Blodgett, K. B., "A Mathematical Investigation of Water Droplet Trajectories," Tech. Rep. 4 No. 5418, Air Materiel Command, AAF, February 19, 1956. (Contract No. W-33-038-AC-9151 with Gen. Elec. Co.)

67. Lenherr, F. E. and Thomson, J. E., "Report on the Computation of Water Drop Trajectories About Six Percent Airfoil at Zero and Four Degrees Angles of Attack," TDM-67A, Northrop Aircraft, Inc., Hawthorne, Calif., October 1952.

68. Lenherr, F. E. and Thomson, J. E., "Preliminary Report on the Computation of Water Drop Trajectories About a 6% Airfoil," Report No.TDM 67, ASTIA AD-160-107, Northrop Aircraft, Inc., June 6, 1952.

69. Lenherr, F. E. and Young, R. W., "Computation of Water Catch on Axial Symmetric Aircraft Radomes," TDM-77, Northrop Aircraft, Inc., December 17, 1951. (Prog. Rep. III, AF33(038)-1817.)

70. Lenherr, F. E., "The Calculation of Water Drop Trajectories for a Circular Cylinder on a Digital Computer," Northrop Aircraft, Inc., AF 339-38-1817, TDM-78, September 1952.

71. Lenherr, F. E., et al, "Report on the Computation of Water Drop Trajectories About Six Percent Airfoil at Zero and Four Degrees Angles of Attack," TDM-67A, Oct. 6, 1952.

72. Lewis, J. P. and Ruggeri, R. S., "Experimental Droplet Impingement on Four Bodies of Revolution," NACA TN 4902, 1957.

73. Lewis, W. and Brun, R. J., "Impingement of Water Droplets on a Rectangular Half Body in a Two-Dimensional Incompressible Flow Field," NACA TN 3658, 1956.

74. McComber, P. and Touzot, G., "Calculation of the Impingement of Cloud Droplets on a Cylinder by the Finite Element Method," Journal of the Atmospheric Sciences, Vol. 38, May 1981, pp. 1027-1036.

75. McKnight, R. C., Palko, R. L., and Humes, R. L., "In-Flight Photogrammer-tic Measurement of Wing Ice Accretions," AIAA Paper 86-0483, 1986.

76. Millar, D. A. J., "Calculation of a Catch of Water by a Jet Engine During High-Speed Flight in Cloud," NAE, Canada, Lab. Rept. No. 78, June 1953.

77. Morton, A. O., "An Investigation of an Experimental Technique for Determining the Trajectory of a Water Droplet in an Airstream," Project No.M992-D, University of Michigan Engineering Research Institute, Master's Thesis, July 1952.

78. Norment, H. G., "Calculation of Water Drop Trajectories To and About Arbitrary Three-Dimensional Lifting and Non lifting Bodies in Potential Flow," NASA Contractor Report 3935, Contract NAS3-22146, October 1985.

79. Norment, H. G., "Calculation of Water Drop Trajectories To and About Arbitrary Three-Dimensional Bodies in Potential Airflow," NACA CR 3291, August 1980.

80. Norment, H. G. and Zalosh, R. G., "Effects of Airplane Flow fields on Hydrometeor Concentration Measurements," AFCRL-TR-74-0602, Dec. 6, 1974, AD-A006-690.

81. Norment, H. G., "Three Dimensional Particle Trajectory Calculation," The Second Icing Analysis, NASA Lewis Research Center, February 8, 1983.

82. Norment, H. G., "Three-Dimensional Airflow and Hydrometer Trajectory Calculation with Applications," AIAA Paper 85-0412, 1985.

83. Papadakis, M., Zumwalt, G. W., Kim, J. J., Elangovan, R., Freund, G. A., Seibel, W., and Breer, M. D., "An Experimental Method for Measuring Droplet Impingement Efficiency on Two and Three-Dimensional Bodies," AIAA-86-0406, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

84. Papadakis, M., Elangovan, R., Freund, G. A., and Breer, M. D., "Experimental Water Droplet Impingement Data on Two-Dimensional Airfoils, Axisymmetric Inlet and Boeing 737-300 Engine Inlets," AIAA Paper No.87-0097, 1987.

85. Perez, R. R. and Shafer, T. R., "A Theoretical Analysis of the Icing Limit for an NACA 0004 Airfoil," WADC Tech.Note 57-106, AD-118-263, April 1957.

86. Reyhner, T. A., "Three-Dimensional Transonic Potential Flow About Complex Three-Dimensional Configurations," NASA CR-3814, 1984.

87. Sartor, J.D. and Abbott, C. E., "Prediction and Measurement of the Accelerated Motion of Water Drops in Air," Journal of Applied Meteorology, Vol. 14, March 1975, pp. 232-239.

88. Savic, P. and Boult, G. T., "The Fluid Flow Associated with the Impact of Liquid Drops with Solid Surfaces," Report No. MT-26, National Research Council of Canada, May 1955.

89. Schmidt, W. F., "Water Droplet Impingement Prediction for Engine Inlet by Trajectory Analysis in a Potential Flow Field - Final Report," Boeing Document D3-6961, December 1965.

90. Serafini, J. S., "Impingement of Water Droplets on Wedges and Diamond Airfoils at Supersonic Speeds," NACA Rep.1159, 1954.(Supersedes NACA TN 2971.)

91. Shaw, R. J., Norment, H. G., and Quaely, A., "The Use of a Three-Dimensional Water Droplet Trajectory Analysis to Aid in Interpreting Icing Cloud Data," AIAA-86-0405, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

92. Shaw, R. J. and Ide, R. F., "The Use of a Three-Dimensional Water Droplet Trajectory Analysis to Aid in Interpreting Icing Cloud Data," AIAA-86- 0405, AIAA 24th Aerospace Sciences Meeting, Reno, Nevada, January 6-9, 1986.

93. Sherman, P., Clein, J. S., and Tribus, M., "Determination of Drop-Trajectories by Means of an Extension of Stokes' Law," Univ. of Michigan, Engr.Res. Inst., April 1952. (Proj. 992-D.)

94. Stark, R. D., "Water-Droplet Trajectory Studies on the NACA 65A005 Airfoil and the IS(50)002-(50)002 Airfoil," Technical Note No.545, Aeronautical Icing Research Laboratories, April 1954.

95. Stock, H. W., "Water Droplet Trajectory Computation Around an Air Intaker," Zeitschrift fur Flugwissenschaftern and Weltraumforschung, Band 8, 1984, Heft 3, pp. 200-208.

96. Tribus, M. and Guibert, A., "Impingement of Spherical Water Droplets on a Wedge at Supersonic Speeds in Air," Jour. Aero. Sci., Vol. 19, No. 6, pp. 391-394, June 1952.

97. Tribus, M. and Rauch, L. L., "A New Method for Calculating Water-Droplet Trajectories About Streamlined Bodies," Univ. of Michigan, Engr. Res.Inst., December 1951. (Proj. M992-E.)

98. Tribus, M., "The Trajectories of Water Drops," Univ. of Mich., Airplane Icing Inf. Course, Lecture 3, 1953.

99. Von Glahn, U. H., "Use of Truncated Flapped Airfoils for Impingement and Icing Tests of Full-Scale Leading-Edge Sections," NACA RM E56E11, 1956.

100. Von Glahn, U. H., Gelder, T. F., and Smyers, Jr., W. H., "A Dye-Tracer Technique for Experimentally Obtaining Impingement Characteristics of Arbitrary Bodies and a Method for Determining Droplet Size Distribution," NACA TN 3338, 1955.

101. Vonnegut, B., "A Capillar Collector for Measuring the Deposition of Water Drops on a Surface Moving Through Clouds," Review of Scientific Instruments, Vol. 20, pp. 110-114, February 1949.

102. Wilder, R. W., "Design Analysis of Water Impingement for C-133A Airplane Empennage and Wing Ice Protection Systems," Douglas Report No. SM-18516, August 1956.

CHAPTER VIII

SECTION 16.0

ICE ACCRETION MODELING

BIBLIOGRAPHY

VIII.16.0 ICE ACCRETION MODELING

1. "Aircraft Icing Research with the Rockliffe Ice Wagon," NAE, Canada,January 1952.

2. "Icing Report by the University of California. Fiscal Year 1946," AAF Tech. Rept. Air Materiel Command, No. 5529, 1946.

3. "Rotorcraft Icing - Status and Prospect," Advisory Gro) for Aerospace Research and Development, ARGARD-AR-166, AD-A106-100/1, Augu. 1981.

4. Ackley, S. F. and Templeton, M. K., "Computer Modeling of Atmospheric Ice Accretion," CRREL-79-4, Army Cold Regions Research and Engineering Lab., 1979.

5. Bragg, M. B., "The Effect of Geometry on Airfoil Icing Characteristics,"AIAA Journal of Aircraft, Vol. 21, No. 7, July 1984, pp. 505-511.

6. Bragg, M. B., "Predicting Rime Ice Accretion on airfoils," AIAA Journal,Vol. 23, No. 3, March 1985, pp. 381-386.

7. Bragg, M. B., Gregorek, G. M., and Lee, J. D., "Experimental and Analytical Investigations Into Airfoil Icing," 14th Congress of the Aeronautical Sciences, Toulouse, France, September 10-14, 1984.

8. Bragg, M. B., Gregorek, G. M., and Shaw, R. J., "An Analytical Approach to Airfoil Icing," AIAA Paper No. 81-0403, Presented at the 19th Aerospace Sciences Meeting, January 12-15, 1981.

9. Burke, P. M. A., "Ice Accretion on Aircraft," Dublin, Eire, Meteorological Service, Technical Note, No. 5, pp. 1-14, 1944.

10. Cansdale, J. T. and Gent, R. W., "Ice Accretion on Aerofoils in Two-Dimensional Compressible Flow - A Theoretical Model," RAE TR 82128, January 1983.

11. Cansdale, J. T. and McNaughtan, I. I., "Calculation of Surface Temperature and Ice Accretion Rate in a Mixed Water Droplet/Ice Crystal Cloud," RAE Technical Report 77090, June 1977.

12. Chang, K., et al, "Influence of Multidroplet Size Distribution on Icing Collection Efficiency," AIAA 83-0028, January 1, 1983.

13. Dickey, T. A., "An Analysis of the Effects of Certain Variables in Determining the Form of an Ice Accretion," U. S. Navy, Naval Air Experimental Station, AEL Report 1206, April 1952.

14. Dietenberger, M., Kumar, P., and Luers, J., "Frost Formation on an Airfoil: A Mathematical Model I," NASA Contract Rept. CR-3129, April 1979.

15. Epperly, P. O., "Instability and Moisture Content as Factors in Ice Accretion on Aircraft in Flight and a Practical Chart for Use in Forecasting Icing Areas," U. S. Weather Bureau, Airport Station, Salt Lake City, April 1940.

16. Flemming, R. J. and Lednicer, D. A., "High Speed Ice Accretion on Rotor-craft Airfoils," American Helicopter Society Paper A-83-39-04-000, 1983.

VIII.16.0 ICE ACCRETION MODELING (CONTINUED)

17. Flemming, R. J. and Lednicer, D. A., "Experimental Investigation of Ice Accretion on Rotorcraft Airfoils at High Speeds," AIAA Paper 84-0183, 1984.

18. Flemming, R. J. and Lednicer, D. A., "High Speed Ice Accretion on Rotor-craft Airfoils," NASA Contractor Report 3910, August 1985.

19. Gates, E. M., Lozowski, E. P., and Liu, A., "A Stochastic Model of Atmospheric Rime Icing," AIAA-86-0405, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

20. Hansman, Jr., R. J., "Droplet Size Distribution Effects on Aircraft Ice Accretion," AIAA 22nd Aerospace Sciences Meeting, Reno, Nevada, January 9-12, 1984, Journal of Aircraft, Vol. 22, No. 6, June 1985.

21. Howell, W. E., "Preliminary Report on Comparative Observations of Ice Accumulation on Airfoils, Spheres, Cones, Ribbons, and Stationary and Rotating Cylinders," Harvard - Mt.Washington Icing Research Report 1946-1947, U.S. Air Materiel Command Tech. Note 5676.

22. Kirchmer, R. D., "Aircraft Icing Roughness Features and its Effect on the Icing Process," AIAA-83-0111, paper presented at the 21st Aerospace Sciences Meeting, Reno, Nevada, January 10-13, 1983.

23. Lai, S., "Icing of Low Drag Wing Section, Part II," Journal Aero. Sci. of India, Vol. 3, No. 2, February 1951.

24. Laschka, B. and Jesse, R. E., "Ice Accretion and Its Effect on Aerodynamics of Unprotected Airfoil Components," Paper No. 4, AGARD Advisory Report No. 127, 1978.

25. London, A. L. and Seban, R. A., "Rate of Ice Formation," ASME, Trans. 65,pp. 771-778, Oct. 1943.

26. Lozowski, E. P. and Oleskiw, M. M., "Computer Modeling of Time Dependent Rime Icing in the Atmosphere," CRREL 83-2, January 1983.

27. Lozowski, E. P., et al, "The Icing of an Unheated, Non rotating Cylinder,Part I: A Simulation Model," NRC Report, Aug. 25, 1983.

28. Lozowski, E. P., et al, "The Icing of an Unheated, Non rotating Cylinder,Part II: Icing Wind Tunnel Experiments," June 8, 1983.

29. Lozowski, E. P., Stallabrass, J. R., and Hearty, P. F., "The Icing of an Unheated Non-Rotating Cylinder in Liquid Water Droplet/Ice Crystal Clouds," NRC Report LTR-LT-96, February 1979.

30. Lozowski, E. P., Stallabrass, J. R., and Hearty, P. F., "The Icing of an Unheated Non-Rotating Cylinder in Liquid Water Droplet/Ice Crystal Clouds," NRC Report LTR-LT-96, February 1979.

31. Lozowski, E. P., Stallabrass, J. R., and Hearty, P. F., "The Icing of an Unheated Rotating Cylinder, Part I: A Simulation Model," Journal of Applied Meteorology, Vol. 22, December 1983, pp. 2053-2062.

32. Lozowski, E. P., Stallabrass, J. R., and Hearty, P. F., "The Icing of an Unheated Rotating Cylinder, Part II: Icing Wind Tunnel Experiments," Journal of Applied Meteorology, Vol. 22, December 1983, pp. 2063-2074.

33. Macklin, W. C. and Payne, G. S., "A Theoretical Study of the Ice Accretion Process," Quarterly Journal of the Royal Meteorological Society, 1967, Vol. 93, pp. 195-213.

34. Macklin, W. C., "The Density and Structure of Ice Formed by Accretion," Quarterly Journal of the Royal Meteorological Society, January 1962, Vol. 88, No. 3375, pp. 30-50.

35. Mazin, N. P., "Calculation of Deposit of Drops on Round Cylindrical Surfaces," Transactions of TSAO, Issue 7, 1952.

36. McArthur, C. D., "Numerical Simulation of Airfoil Ice Accretion," AIAA Paper 83-0112, 1983.

37. McArthur, C. D., Keller, J. L., and Luers, J. K., "Mathematical Modeling of Ice Accretion on Airfoils," AIAA Paper 82-0284, 1982.

38. Mikkelsen, K. J., McKnight, R. C., Ranaudo, R. J., and Perkins, Jr., P., "Icing Flight Research: Aerodynamic Effects of Ice, and Ice Shape Documentation with Stereo Photography," AIAA Paper 85-0468, January 1, 1985.

39. Millar, D. M., "Investigation of Ice Accretion Characteristics of Hydrophobic Materials," FAA-DS-70-11, Federal Aviation Administration, National Aviation Facilities Experimental Center, Atlantic City, New Jersey, May 1970.

40. Minsk, L. D., "Ice Accretion Tests on Coatings Subjected to Rain Erosion," CRREL Special Report 80-28, July 1980.

41. Missimer, J. R., et al, "Gaining Insight into the Physics of the Ice Accretion Process Through Scaling," Sikorsky Aircraft Icing Bibliography.

42. Murphy, W. J. H. and Waterman, T. E., "Glaze Ice-Forming Characteristics of Various Structural Shapes," RADC TN 59-411, June 1959.

43. Oleskiw, M. M., "A Computer Simulation of Time Dependent Rime Icing on Aerofoils," Ph.D.Thesis, Division of Meteorology, Univerity of Alberta, 1981.

44. Olsen, Jr., W. A., "Close-Up Movies of the Icing Process on the Leading Edge of an Airfoil," NASA Lewis Research Center, Movie C-313, 1985.

45. Palco, R. L., Cassady, P. L., McKnight, R. C., and Freedman, R. J., "Initial Feasibility Ground Test of a Proposed Photogrammetric System for Measuring the Shapes of Ice Accretions on Helicopter Rotor Blades During Forward Flight,"AEDC-TR 84-10, August 1984.

46. Pchelko, I. G., "A Method of Determining the Range of Airplane Icing,"FSTC-HT-23-1818-73, AD-781-221/7, July 16, 1974.

47. Quan, B. and Wenham, H. G., "Some Tests of a Refrigerated Rotating Cylinder for Measuring Ice Accretion," NAE, Canada, Laboratory Rept.No. 45, May 1952.

48. Ruff, G. A., "Development of an Analytical Ice Accretion Prediction Method (LEWICE)," Unpublished paper, 1986.

49. Schwartz, H., "A Modified Method of Determining the Rate of Ice Accretion on an Airfoil in an Icing Condition," WADC TN No. WCT 54-106, Rept. No.R208-17, October 1954.

50. Shaw, R. J., Sotos, R. G., and Solano, F. R., "An Experimental Study of Airfoil Icing Characteristics," NASA TM 82790, January 1982.

51. Stallabrass, J. R. and Hearty, P. F., "Further Icing Experiments in an Unheated Non-Rotating Cylinder," NRC Report LTR-LT-105, November 1979.

52. Stallabrass, J. R. and Lozowski, E. P., "Ice Shapes on Cylinders and Rotor Blades," NATO Army Armaments Group, Panel X, Helicopter Icing Symposium, London, November 1978.

53. Wilder, R. W., "Techniques Used to Determine Artificial Ice Shapes and Ice Shedding Characteristics of Unprotected Airfoil Surfaces," Presented at the Federal Aviation Administration Symposium on Arcraft Ice Protection, Washington, D. C., April 28-30, 1969.

54. Wilder, R. W., "Theoretical and Experimental Means to Predict Ice Accretion Shapes for Evaluating Aircraft Handling and Performance Characteristics," AGARD Advisory Report 127, Paper 5, September 30, 1977, Published 1978.

55. Zaguli, R. J., "Potential Flow Analysis of Glaze Ice Accretions on an Airfoil ," NASA CR-168282, January 1984.

CHAPTER VIII

SECTION 17.0

ICING TEST FACILITIES AND SIMULATION

BIBLIOGRAPHY

VIII.17.0 ICING TEST FACILITIES AND SIMULATION

1. "Bibliography on Sprays," Texas Oil Company (The Penn State), 2nd. Edition, 1953.

2. "Experimental Determination of the Degree of Cooling of Spray Droplets," Staff of the Low Temperature Laboratory, NRC Report LTR-LT-24, October 1970.

3. "Icing Wind Tunnel Facility," Research Incorporated, Hopkins, Minnesota.

4. "Lockheed-California Company Icing Tunnel Tests on Douglas DC-9 Horizontal Stabilizer Models," Lockheed Report LFL T-32, August 23, 1965.

5. "Proceedings and Minutes of the National Icing Facilities Coordination Meeting Held at the FAA Technical Center," Atlantic City, N. J., September 1980.

6. "Research and Development Report to Industry," FAA, Washington, D. C.

7. "Tests of a Water Spray Rig for Simulating Icing Condition Ahead of a Turbine Engine in Flight," RAE, TN Mech. Engr. 58.

8. "Wind Tunnel Evaluation of Limited Type Ice Removal and Prevention System," Research, Inc., WADC TR 56-413, AD-110-714, October 1956.

9. Adams, K., "The Air Force Flight Test Center Palletized Airborne Water Spray System," AIAA-83-0030, January 1983.

10. Armand, C. and Charpin, F., "Icing Testing in the Large Modane Wind Tunnel on a Reduced-Scale Model of a Helicopter Rotor," (Translation) Cold Regions Research and Engineering Lab., Hanover, N. H., CRREL-TL-523, AD-A030-110/1SL, May 1976.

11. Armand, C., Charpin, F., Fasso, G., and Leclere, G., "Techniques and Facilities Used at the Onera Modane Centre for Icing Tests," AGARD Advisory Rep. 127, Paper A6, September 30, 1977, Published 1978.

12. Aron, K. M., Herman, M. A., Parikh, P., Sarohia, V., and Gharib, M., "Simulation and Analysis of Natural Rain in a Wind Tunnel via Digital Image Processing Techniques," AIAA-86-0291, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986, Reno, Nevada.

13. Bailey, D. L., "Description of the Spray Rig Used to Study Icing on Helicopters in Flight," NRC Report LR-186-A, September 1960.

14. Ball, R. G. J. and Prince, A. G., "Icing Tests on Turbojet and Turbofan Engines Using the NGTE Engine Test Facility," AGARD Conf. Proc. No. 236, Ice Test for Aircraft Engines, Paper 11, August 1978.

15. Bartlett, C. Scot, "Analytical Study of Icing Similitude for Aircraft Engine Icing," DOT/FAA/CT-86/35, AEDC-TR-86-26, October 1986.

16. Barlett, P. M. and Dicket, T. A., "Gas Turbine Icing Tests at Mt. Washington," SAE Paper presented in Los Angeles, 1950.

17. Bartlett, P. M. and Dickey, T. A., "Turbine-Engine Anti-Icing Tested Atop Mt. Washington," SAE, Journal, Vol. 59, pp. 25-28, January 1951.

18. Beard, K. V. and Pruppacher, H. R., "A Determination of the Terminal Velocity and Drag of Small Water Drops by Means of a Wind Tunnel," Journal of Atmospheric Science, 1969, Vol. 26, No. 5, pp. 1066-1072.

19. Belte, D., "Helicopter Icing Spray System (HISS) Nozzle Improvement Evaluation," USAAEFA-79-02-2, AD-A109-405/1, September 1981.

20. Belte, D., "Helicopter Icing Spray System Improvements and Flight Experience," Canadian Aeronaut. Space J., Vol. 27, No. 2, Second Quarter 1981, pp. 93-106.

21. Belte, D., "Helicopter Icing Spray System," Proc. Annu. Symp. Soc. Flight Test Eng. 11th, Flight Test in the Eighties, Paper 4, 1980.

22. Bender, G.L., Mathews III, M. S., and Tulloch, J. S., "Modified Helicopter Icing Spray System Evaluation," USAAEFA-75-04, AD-A055-0392SL, March 1977.

23. Berg, A. L. and Wolf, H. E., "Aircraft Engine Icing Test Techniques and Capabilities at the AEDC," McDonnell Douglas Corporation, January 26, 1976.

24. Berg, C. B. and Stark, R., "Design Study - Interim Icing Wind Tunnel,"Project No. R208-19-16 (Confidential.)

25. Berger, J. H. and McDonald, T. J., "Wind Tunnel Tests of Airfoil Shapes Altered by Icing and Airfoil Shapes with Deicer Boots," Fluidyne Report 1402, January 1984.

26. Bigg, F. J., "The Atomization of Water by Air Blast Nozzles for the Simulation of Cloud Conditions for Icing Research," RAE Tech.Note, Mech.Eng.203, 1955.

27. Boelter, L. M. K., Young, G., and Tribus, M., "The Limitations and Mathematical Basis for Predicting Aircraft Icing Characteristics from Scale Model Studies," UCLA, July 1946.

28. Bongrand, J., "Icing Test Facilities," AGARD Conf. Proc. No. 236, Ice Test for Aircr. Engines, Paper 5, August 1978.

29. Bongrand, J., "Theoretical and Experimental Study of the Effect of Various Parameters on the Icing of an Airfoil," AGARD Conference Proc.No. 236, Ice Test for Aircraft Engines, Paper 10, April 3-4, 1978, Published August 1978.

30. Bonin, P. R. and Jefferis, R. P., "Icing Tunnel Test - Hot Film Anemo-meter," USAASTA-73-04, AD/A-005 044/3SL, February 1974.

31. Bragg, M. B., Gregorek, G. M., and Shaw, R. J., "Analytical Approach to Airfoil Icing," AIAA Paper 81-0403, AIAA 19th Aerospace Sciences Meeting, January 12-15, 1981.

32. Bragg, M. B., Zaguli, R. J., and Gregorek, G. M., "Wing Tunnel Evaluation of Airfoil Performance Using Simulated Ice Shapes," NASA CR-167960, 1982.

33. Chappell, M. S., "A Resume of Simulation Techniques and Icing Activities at the Engine Laboratory of the National Research Council (Canada)," NRC Report LR-305, May 1961.

34. Charpin, F. and Fasso, G., "Icing Testing in the Large Modane Wind-Tunnel on Full-Scale and Reduced Scale Models," NASA TM-75373, March 1979.

35. Cheverton, B. F., "The Icing Research Aircraft," Aircraft Ice Protection Conference, D. Napier and Son, Ltd., May 1960.

36. Cheverton, B. T., Sharp, C. R., and Badham, L. G., "Spray Nozzles for the Simulation of Cloud Conditions in Icing Tests of Jet Engines," N.A.E.C., Ottawa, No. 14, 1951.

37. Clareus, U., "Ice Simulation: A 2-Dimensional Wind Tunnel Investigation of a NACA 652A215 Wing Section with Single Slotted Flap.Part 2: Configurations Typical for Transport Airplanes," FFA-TN-AU-995-PT-2, June 1974.

38. Coled, W. D., "Icing Limit and Wet-Surface Temperature Variation for Two Airfoil Shapes Under Simulated High-Speed Flight Conditions," NACA TN 3396, 1955.

39. Cowlin, C. J. and Lazelle, B. D., "The Installation and Calibration of a Higher Speed Wind Tunnel at the Arlington Cold Stores," D.Napier and Sons, Report DEV/TR/116/915, 1953.

40. Cubbison, R. W., Newton, J. E., and Schabes, H. L., "Losses Across the Icing Research Tunnel "A" Corner and the Increase in Loss Due to Ice Accretion on the Turning Vanes," NASA Lewis Research Center, In-House Report, 1984.

41. Cullen, R. E., et al, "Some Considerations and Preliminary Experiments of an Air-Cycle System for Refrigeration and Production of Drops in Connection with an Icing Wind Tunnel," Univ. of Mich. Eng. Res. Inst., WADC Tech. Report 54-256, 1954.

42. Delgado, L. V., "Icing Nozzle Element Optimization Test, January 1979," Air Force Geophysics Lab., Hanscom AFB, Ma., AFGL-TR-79-O193, AFGL-IP- 279, AD-A081-175/2, August 20, 1979.

43. Delgado, L. V., "Air Force Geophysics Lab Hanscom AFB MA Icing Nozzle Element Optimization Test, January 1979," AFGL-TR-79-0193, AD-A081-175, Aug. 1, 1979.

44. DeWitt, K. J., Keith, T. G., Chao, D. F., and Masiulaniec, K. C., "Numerical Simulation of Electrothermal Deicing Systems," AIAA Paper 83-0114, 1983.

45. Dietenberger, M. A., "Simulated Aircraft Takeoff Performance with Frosted Wings," AIAA Aerosp. Sci. Meet., 19th, AIAA Paper 81-0404, 1981.

46. Dietenberger, M. and Luers, J., "Computer Simulation Developments for Prediction of Frost Severity on Aircraft Takeoff Performance," University of Dayton, Presented at Conference on Atmospheric Environment of Aerospace Systems and Applied Meteorology, New York, New York, November 1978.

47. Dietenberger, M., et al, "Frost Formation on an Airfoil: A Mathematical Model I," NASA CT-3129, N79-22706/2, Jan. 1, 1979.

48. Dodson, E. D., "Scale Model Analogy for Icing Tunnel Testing," D66-79076,Boeing Airplane Company, 1966.

49. Eyre, D., "Wind Tunnel Tests of an Airborne Iso-Kinetic Ice Crystal Decelerator," NOAA-TM-ERL-APCL-18, N0AA-74102104, September 1974.

50. Fasso, G., "Rain and Deicing Experiments in a Wind-Tunnel," Association Francaise des Ingeieurs et Techniciens de L'Aeronautique, 8th, May 29-31, 1967, Paper.(In French.)

51. Flemming, R. J. and Lednicer, D. A., "Correlation of Airfoil Icing Relationships with Two-Dimensional Model and Full Scale Rotorcraft Icing Test Data," AIAA Paper 85-0337, 1985.

52. Flemming, R. J. and Lednicer, D. A., "Experimental Investigation of Ice Accretion on Rotorcraft Airfoils at High Speeds," AIAA Paper 84-0183, 1984.

53. Flemming, R. J., Shaw, R. J., and Lee, J. D., "The Performance Characteristics of Simulated Ice in Rotorcraft Airfoils," AHS 41st Annual Forum Proceedings, May 1985.

54. Flower, J. W., "Determination of Ice Deposition on Slender Wings: An Experimental Technique and Simplified Theory," Int. Council of the Aeronaut. Sci. (ICAS), 9th Congr. Proc., Vol. 1, 1974.

55. Franklin, C. H., "Model Airfoil Tests in High Speed Icing Wind Tunnel," Technical Note No.569, Aeronautical Icing Research Laboratories, September 1960.

56. Fraser, D., "Icing Experiments in Flight and Comparisons with Wind Tunnel Testing," Presented to AGARD 5th General Assembly, Ottawa, June 1955.

57. Friedlander, M., "Test Methods for the Behaviour of Aircraft in Icy Conditions and for Protection Systems Against Icing," AGARD Conference Proc. No. 299, Subsystem Testing and Flight Test Instrumentation, Paper 20, pp. 1-9, 1981.

58. Gaal, E. S. and Floyd, F. X., "Icing Test Capability of the Engine Test Facility Propulsion Development Test Cell (J-1)," Arnold Engineering Development Center, Report AEDC-TR-71-94, AD-729-205, August 1971.

59. Galitzine, N., Sharp, C. R., and Badham, L. G., Spray Nozzles for the Simulation of Cloud Conditions in Icing Tests of Jet Engines," NRC Report ME-186, August 1950.

60. Gelder, T., Moore, J., and Sanz, J., "Wind Tunnel Turning Vanes of Modern Design," NASA TM-87416, 1986.

61. Golitzine, N., Sharp, C. R., and Badham, L. G., "Spray Nozzles for the Simulation of Cloud Conditions in Icing Tests of Jet," N.A.E.C., Report No. 14, Ottawa, 1951.

62. Gregorek, G. M., Bragg, M. B., Freuler, R. J., Nikkelsen, K. L., and Hoffman, M. J., "NASA Twin Otter Flight Test Program-Comparison of Flight Results with Analytic Theory," SAE Paper 850924, April, 1985.

63. Guffond, D., "Wind Tunnel Study of Icing and De-Icing on Oscillating Rotor Blades," Paper No. 6, Eighth European Rotorcraft Forum, September 1982.

64. Guffond, D., Cossaing, J., and Brunet, L., "Overview on Icing Research at ONERA," AIAA 85-0335, paper presented at the 23rd Aerospace Sciences Meeting, Reno, Nevada, January 14-17, 1985.

65. Haines, A. B., "Comparative Tests on Propellers with Simulated Ice and with De-Icing Overshoes in 24-Foot Tunnel," ARC R&M No. 2397, 1946.

66. Hanks, M. L. and Woratschek, R., "HISS Boom Structural Dynamics Evaluation with Fiberglass Blades, Letter Report," USAAEFA-82-05-1, August 31, 1982.

67. Hauger, H. H. and Englar, K. G., "Analysis of Model Testing in an Icing Wind Tunnel," Douglas Aircraft Company, Inc., Report No. SM14933, 1954.

68. Hayden, J. S., Bailes, E. E., Watts, J. C., and Brewer, L. K., "Helicopter Icing Spray System Qualification," USAASTA-72-35, AD-775-803/0, October 1973.

69. Henderson, J. C., Woratschek, R., and Haworth, L. A., "HISS Calibration, Ice Phobics and FAA R/D Evaluations," USAAEFA-80-13, AD-A114-435/1, August 1981.

70. Henschke, G. E., Peterson, A. A., Lunn, K., and Masters, C. O., "Research Effort Plan for Aircraft Icing Certification Without Natural Icing Testing," AIAA-86-0479, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

71. Hoffman, H. E., "First Stage of Equipment for Aircraft DO 28 of DFVLR as a Research Aircraft for Icing and First Research Results," DFVLR-FB-83-40, N84-24571, Feb. 15, 1984.

72. Howell, W. E. and Whipple, P., "Lapse Rate in Relation to Icing," Harvard-Mt. Washington Icing Research Report 1946-1947, U. S. Air Materiel Command, Tech. Rept. No. 5676.

73. Howell, W. E., "Preliminary Report on the Relation of Icing to Turbulence at Mount Washington," Harvard-Mt.Washington Icing Research Report 1946-1947, U. S. Air Materiel Command, Tech. Rept. 5676.

74. Howell, W. E., "A Comparison of Icing Conditions on Mount Washington with Those Encountered in Flight," Mt. Washington Observatory, 1949.

75. Humbert, M. E., et al, "Droplet Size and Liquid Water Characteristics of the USAAEFA (CH-47) Helicopter Spray System and Natural Clouds as Sampled by a JUH-1H Helicopter," MIR-80-FR-1748, AD-A107-578/7, Aug. 1, 1980.

76. Humbert, M. E., et al, "Natural and HISS Cloud Droplet Data as Sampled During the 1980-1981 AFEA/ST Paul Field Program," MIR-81-FR-1813, AD-A107-574/9, Sept. 1, 1981.

77. Hunt, J. D., "Engine Icing Measurement Capabilities at the AEDC," AGARD Conf. Proc. No. 236, Ice Test for Aircraft Engines, Paper 4, August 1978.

78. Hunt, Jay D., "Spray Nozzle Calibrations," AEDC-TR-85-65, January 1986.

79. Idzorek, J. J., "Observations on the Development of a Natural Refrigeration Icing Wind Tunnel," AIAA-87-0175, AIAA 25th Aerospace Sciences Meeting, January 12-15, 1987, Reno, Nevada.

80. Ikrath, K., "Interference with Aircraft Radio Navigation and Communications by Precipitation Static from Ice and Snow Clouds (Electrostatic Wind Tunnel Experiments)," Army Electronics Command, Fort Monmouth, N.J., ECOM-4244, AD-784-623/1, August 1974.

81. Ivaniko, A., Trunov, O. K., and Yelistratov, V., "The Elaboration of Ice Simulator Techniques for the Assessment of Icing Effects on Aerodynamic Characteristics of Icing," State Research for Civil Aviation, 3rd Meeting of the Working Group, USSR, September 1974.

82. Jackson, E. T., "Development Study: The Use of Scale Models in an Icing Tunnel to Determine the Ice Catch on a Prototype Aircraft with Particular Reference to Concorde," British Aircraft Corporation (operating) Ltd., Filton Division, SST/B75T/RMMcK/242, July 1967.

83. Karlsen, L. K. and Salberg, A., "Digital Simulation of Aircraft Longitudinal Motions with Tailplane Ice," KTH Aero Report 55, Dept.of Aeronautics, The Royal Institute of Technology, Stockholm, Sweden, 1983.

84. Kawa, M. M. and Burpo, F., "Test of an Experimental Helicopter Deicing System on an H-13H Helicopter. Part I. Results of Tests of the Experimental Helicopter Deicing System in the NAE Spray Tower at Ottawa, Canada," NOAS58, AS-242-230, May 1958.

85. Keith, Jr., T. G., et al, "Predicted Electrothermal De-Icing of AircraftBlades," AIAA-84-0110, January 1984.

86. Keller, R. G., "Measurement and Control of Simulated Environmental Icing Conditions in an Outdoor, Free Jet, Engine Ground Test Facility," AGARD Conf. Proc. No. 236, Ice Test for Aircraft Engines," Paper 5, August 1978.

87. Kingery, W. D., "Summary Report - Project Ice Way," Air Force CambridgeResearch Labs., AFRCL-62-498, May 1962.

88. Kitchens, P. F. and Adams, R. I., "Simulated and Natural Icing Tests of an Ice Protected UH-1H," Presented at 33rd Annual National Forum of the American Helicopter Society, Washington, D. C., "Preprint No. 77-33-25, May 1977.

89. Knight, M. and Clay, W. C., "Refrigerated Wind Tunnel Tests on Surface Coatings for Preventing Ice Formation," NACA TN 339, May 1930.

90. Kohlman, D. L., Schweikhard, W. G., Albright, A. E., and Evanich, P., "Icing Tunnel Tests of a Gycol-Exuding Porous Leading Edge Ice Protection System on a General Aviation Airfoil," NASA CR-164377, KU-FRL-465-1, May 1981.

91. Kohlman, D. L., Schweikhard, W. G., and Albright, A. E., "Icing Tunnel Tests of a Glycol - Exuding Porous Leading Edge Ice Protection System on a General Aviation Airfoil," NASA Contractor Report 165-444, September 1981.

92. Kohlman, D. L., Schweikhard, W. G., and Evanich, P., "Icing Tunnel Tests of a Glycol-Exuding Porous Leading Edge Ice Protection System on a General Aviation Airfoil," AIAA Paper 81-0405, AIAA Aerosp. Sci. Meet.19th, January 12-15, 1981.(Also NASA CR-165444.)

93. Kohlmann, D. L. and Albright, A. E., "A Method of Predicting Flow Rates Required to achieve Anti-Icing Performance with a Porous Leading Edge Ice Protection System," NASA CR-168213.

94. Kronenberger, Jr. L., et al, "Artificial Icing Tests, Lockheed Advanced Ice Protection System Installed on a UH-1H Helicopter," USAAEFA-74-13, June 1975.

95. Krouse, J. R., "Preliminary Estimates of the Test-Section Characteristics in a High-Enthalpy, Low Density Wind Tunnel," David Taylor Model Basi Washington, D. C., DTMB-1921, AD-455-149, September 1964.

96. Lazelle, B. D., "Conditions to Prevent Freeze-Cut During Atomization of Water Sprays for Icing Cloud Simulation," Reference DEV/TN/262/778, D.Napier and Son Limited, August 1958.

97. Lazelle, B. D., "Rolls Royce Air Blast Atomizers," Napier ReportDEV/TR/158/928.

98. Lazelle, B. D., "Calibration of the Napier Air Blast Water Atmoizer with 0.018 In. Diameter Water Jet," Napier Report DEV/TR/133/913.

99. Lazelle, B. D., "Icing Wing Tunnels," Aircraft Ice Protection Conference, D. Napier and Son, Ltd., May 1962.

100. Lee, J. D., Gregorek, G. M., and Korkan, K. D., "Testing Techniques and Interference Evaluation in the OSU Transonic Airfoil Facility," AIAA 11th Fluid and Plasma Dynamics Conference, Paper 78-1118, July, 1978.

101. Lenherr, F. E., "Final Report Development of Spray System," TDM-68-III, Northrop Aircraft, Inc., January 15, 1953.

102. Lewis, J. P., "Wind-Tunnel Investigation of Icing of an Engine Cooling-Fan Installation," NACA TN 1246, 1947.

103. Lozowski, E. P. and Oleskiw, M. M., "Computer Simulation of Airfoil Icing Without Runback," AIAA Paper No. 81-0402, 19th Aerospace Sciences Meeting, January 12-15, 1981.

104. Lozowski, E. P. and Oleskiw, M. M., "Computer Modeling of Time-Dependent Rime Icing in the Atmosphere," CRREL 83-2, January 1983.

105. Lozowski, E. P., Stallabrass, J. R., and Hearty, P. F., "The Icing of an Unheated Rotating Cylinder, Part I: A Simulation Model," Journal of Applied Meteorology, Vol. 22, December 1983, pp. 2053-2062.

106. Lozowski, E. P., Stallabrass, J. R., and Hearty, P. F., "The Icing of an Unheated Rotating Cylinder, Part II: Icing Wind Tunnel Experiments," Journal of Applied Meteorology, Vol. 22, December 1983, pp. 2063-2074.

107. Marano, J. J., "Numerical Simulation of an Electrothermal Deicer Pad," NASA Contractor Report 168097, March 1983.

108. Marek, John and Olsen, William A., Jr., "Turbulent Dispersion of the Icing Cloud from Spray Nozzles Used in Icing Tunnels," Proceedings of the Third International Workshop on Atmospheric Icing of Structures, Paper 2.8, Vancouver, B.C., May, 1986.

109. Masiulaniec, K. K., Keith, T. G., Dewitt, K. J., and Leffel, K., "Full Two-Dimensional Transient Solutions of Electrothermal Aircraft Blade De-Icing," AIAA Paper 85-0413, 1985.

110. Mastroly, F. R., Petach, A. M., and Werner, J. B., "AH-56A Compound Helicopter Icing Spray-Rig Tests," AHS, AIAA, and U. of Texas, Proc. of Joint Symposium on Environmental Effects on VTOL Designs, Arlington, Tex., November 16-18, 1970.

111. Millar, D. A. J., "Assessment of a Proposed Jet Engine Icing Test Bed for Simulating High Speed Flight," NRC Report LR-124, February 1955.

112. Milsum, J. H., "Third Annual Report of Operations of North Start Icing Research Aircraft," Final Season 1953-1954, N.A.E.Test Report 266, 1955.

113. Mittag, O'Connor, Hanks, and Kronenberger, "Artificial Icing Tests, CH-47C Helicopter. Final Report," USAAEFA-73-04-1, August 1974.

114. Newton, J. E. and Olsen, W., "An Ice Accretion Study on an Icing Research Wind Tunnel," AIAA-86-0290, AIAA 24th Aerospace Sciences Meeting," January 6-9, 1896.

115. Newton, James E. and Olsen, William A., "Study of Ice Accretion on Icing Wind Tunnel Components," NASA IM 87095, Prepared for the Twenty-Fourth Aerospace Sciences Meeting Sponsored by the AIAA, Reno, Nevada, January 6-8, 1986.

116. Nicholls, N. A., et al, "Design of an Icing Wind Tunnel," Univ.of Michigan Eng. Res. Inst., Project M. 992-C, 1952.

117. Niemann, Spring, and Bowers, "Artificial Icing Test CH-47C Helicopter With Fiberglass Rotor Blades, Final Report," USAAEFA-78-18, July 1979.

118. Noonan, K. W. and Bingham, G. J., "Aerodynamic Characteristics of Three Helicopter Rotor Airfoil Sections at Reynolds Numbers from Model Scale to Full Scale at Mach Numbers From 0.35 to 0.90," NASA Technical Paper 1701, 1980.

119. Olsen, W. A., "Survey of Aircraft Icing Simulation Test Facilities in North America," NASA TM-81707, 1981.

120. Olsen, W. and Newton, J., "Experimental and Analytical Evaluation of Icing Scaling Laws, A Progress Report," NASA 1M-88793, August 1986.

121. Olson, W., "Experimental Evaluation of Icing Scaling Laws: A Progress Report," AIAA-86-0482, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986, Reno, Nevada.

122. Pierre, M. and Vaucherer, X., "Icing Test Facilities and Test Techniques in Europe," AGARD Advisory Report No. 127, November 1978.

123. Reinman, J. J., Shaw, R. J., and Olsen, Jr., W. A., "Aircraft Icing Research at NASA," First International Workshop on Atmospheric Icing of Structures, Hanover, New Hampshire, NASA TM-82919, 1982.

124. Reinmann, J. J., Shaw, R. J., and Olsen, W. A., "NASA Lewis Research Center's Program on Icing Research," AIAA Paper 83-0204, NASA 1M-83031.

125. Rifkin, H. and Gensemer, A. E., "Icing Tunnel Test Results of C-141 Horizontal Stabilizer Cyclic Electrical De-Icing System," San Diego, Calif., General Dynamics/Convair, November 1962.

126. Ringer, T. R., "Icing Test Facilities in Canada," AGARD Advisory Report No.127, Aircraft Icing, Paper 7, 1977.

127. Robbins and Gilmore, "Limited Artificial Icing Tests of the OV-ID, Letter Report," USAAEFA-80-16, July 9, 1981.

128. Ross, R., "Application of EIDI to the NASA Lewis AWT Turning Vanes,"AIAA-86-0548, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

129. Ruff, G. A., "Verification and Application of the Icing Scaling Equations," AIAA-86-0481, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

130. Ruff, G. A., "Analysis and Verification of the Icing Scaling Equations,"AEDC-TR-85-30, Vol. 1, November 1986.

131. Ruff, G. A., "Development of an Analytical Ice Accretion Prediction Method (LEWICE)," Unpublished paper, 1986.

132. Ruff, Gary A., "Analysis and Verification of the Icing Scaling Equations," AEDC-TR-85-30, Volume I (Revised), Final Report, March 1986.

133. Rush, C. K. and Wardlaw, R. L., "Wind Tunnel Simulation of Atmospheric icing Conditions," N.A.E., Canada, 5th Gen. Ass. AGARD, 1955.

134. Rush, C. K., "The N.R.C.Icing Wind Tunnels and Some of Their Problems,"NRC Report LR-133, April 19, 1955.

135. Rush, C. K., "Note on Icing Simulation," NAE, Canada, No. LT-29, July 1952.

136. Schumacher, P., "Simulated Flight Icing Tests with a Tanker Aircraft,"Aircraft Ice Protection Conference, D. Napier and Son, Ltd., May 1962.

137. Shaw, R. J., "Progress Toward the Development of an Aircraft Icing Analysis Capability," AIAA Paper 84-0105, NASA TM-83562, 1984.

138. Shaw, R. J., Sotos, R. G., and Solano, F. R., "An Experimental Study of Airfoil Icing Characteristics," NASA TM-82790, 1982. 139. Sibley, P. J. and Smith, Jr., R. E., "Model Testing in an Icing Wind Tunnel," Report No. LR 1091, Lockheed Aircraft Corp., October 14, 1955.

140. Smith, E. L. and Ballard, O. R., "A Method for Calculating the Evaporation from Water Sprays in an Icing Tunnel," NRC Report LR-60, May 1953.

141. Smith, M. E., Arimilli, R. V., and Keshock, E. G., "Measurement of Local Convective Heat Transfer Coefficients of Four Ice Accretion Shapes," University of Tennessee, NASA Contractor Report 174680, May 1984.

142. Spence, A., "Further Wind Tunnel Tests on the Effects of Ice Accretion on Control Characteristics," RAE, TN No. AERO 2048, May 1950.

143. Stubbs, H. E., Canfield, H. H., and Nichols, A., "A Drop-Size Study in the Icing Wind Tunnel," Project M992-3, University of Michigan Engineering Center Research Institute, Wright Air Development Center, June 1953.

144. Swift, R. D., "Icing Test Facilities at the National Gas Turbine Establishment," AGARD Conference Proc. No. 236, Ice Test for Aircraft Engines, Paper 4, April 3-4, 1978, publ. August 1978.

145. Tavares, Hanks, Sullivan, and Woratschek, "Artificial and Natural Icing Tests YEH-60A Quick Fix Helicopter, Final Report," USAAEFA-83-21, unpublished.

146. Taylor, F. R. and Adams, R. J., "National Icing Facilities Requirements Investigation," Systems Control, Inc. (VT.), FAA-CT-86/4, June 1981.

147. Taylor, G. I., "Notes on Possible Equipment and Technique for Experimenton Icing on Aircraft," British A.R.C., R. & M.No. 2024, January 1940.

148. Thompson, J. K., "Technical and Practical Aspects of Systems for Simulating Clouds for Flight Test Evaluations," WADC Technical Memorandum WADC-TM-59-3, September 1959.

149. Toliver, R. D., "Unique Test Capabilities of the Eglin AFB McKinley Climatic Laboratory."

150. Tribus, M. and Clein, J., "Calculations on Drop Size Growth and SuperSaturation of Air in an Icing Wind Tunnel," Univ. of Mich., Eng. Res.Inst., Project No. 992-3, 1953.

151. Tribus, M., Young, C. B. W., and Boelter, J. M. K., "Limitations and Mathematical Basis for Predicting Aircraft Icing Characteristics from Scale-Model Studies," Transactions of the A.S.M.E., Vol. 70, No. 8, November 1948.

152. Weiner, F. R., "Use of the Ko Correlation in Preliminary Design and Scale Model Icing," North American Aviation, Report No. NA-65-126, February 1964.

153. Wilder, R. W., "A Theoretical and Experimental Means to Predict Ice Accretion Shapes for Evaluating Aircraft Handling and Performance Characteristics," Paper No. 5 in "Aircraft Icing," AGARD-AR-127, November 1978.

154. Willbanks, C. E. and Schulz, R. G., "Analytical Study of Icing Simulation for Turbine Engines in Altitude Test Cells," J.Aircr. Vol. 12, No. 12, pp. 960-967, December 1975.

155. Willbanks, C. E. and Schulz, R. J., "Analytical Study of Icing Simulation for Turbine Engines in Altitude Test Cells," Arnold Engineering Development Center Rep. AEDC-TR-73-14, AD-770-069, November 1973.

156. Willis, J. M. N., "Effects of Water and Ice on Landing," RAE, Symposium on Aircraft Take-Off and Landing Problems, England, 1962, Shell Aviation News, No. 296, pp. 16-20, 1963. 157. Wilson, C. S. and Atkins, P. B., "An Investigation into the Ice Build Up on the Nozzle Matrix of the "Pegasus" Icing Spray System," Aeronautical Research Labs., Melbourne, Australia, ARL/MECH-ENG-TM-397, AD-A094-389/4, December 1979.

158. Wilson, E. G., "Spray Rig of the Experimental Fluid Anti-Icing System,"AAEE/874/6-PT.8, AD-462-351L, October 1964.

159. Wilson, G. W. and Woratschek, R., "HISS Evaluation and Improvement, Letter Report," USAAEFA-80-04, June 4, 1981.

160. Woratschek, R., "HISS Evaluation and Improvement Letter Report,"USAAEFA-80-04-2, June 22, 1982.

161. Wuori, A. F., "Snow Stabilization Using Dry Processing Methods," TR-68,AD-652-710, July 1960.

162. Zumwalt, G. W., "Icing Tunnel Test of Electro-Impulse De-Icing of an Engine Inlet and High Speed Wings," AIAA-85-0466, AIAA 23rd Aerospace Sciences Meeting, January 14-19, 1985.

163. Zumwalt, G. W., "Flight and Wind Tunnel Tests of an Electro-Impulse De-Icing System," AIAA-85-2234, January 1985.

CHAPTER VIII

SECTION 18.0

AIRFOIL AND AIRCRAFT PERFORMANCE DEGRADATION

BIBLIOGRAPHY

VIII.18.0 AIRFOIL AND AIRCRAFT PERFORMANCE DEGRADATION

1. Bowden, D. T., "Effect of Pneumatic De-Icers and Ice Formations on Aerodynamic Characteristics of an Airfoil," NACA TN 3564, February 1956.

2. Bragg, M. B. and Coirier, W. J., "Detailed Measurements of the Flow Field in the Vicinity of an Airfoil with Glaze Ice," AIAA Paper 85-0409, 1985.

3. Bragg, M. B. and Collier, W. J., "Aerodynamic Measurements of an Airfoil with Simulated Glaze Ice," AIAA-86-0484, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

4. Bragg, M. B. and Gregorek, G. M., "Aerodynamic Characteristics of Air-foils with Ice Accretions," AIAA Paper 82-0282, 1982.

5. Bragg, M. B. and Gregorek, G. M., "Predicting Aircraft Performance Degradation Due to Ice Accretion," SAE Technical Paper 830742, 1983.

6. Bragg, M. B. and Gregorek, G. M., "Effect of Rime Ice Accretion on Airfoil Performance," Ohio State University, March 1981.

7. Bragg, M. B., "Rime Ice Accretion and Its Effect on Airfoil Performance,"NASA CR-165599, March 1982.

8. Bragg, M. B., "Predicting Airfoil Performance with Rime and Glaze Ice Accretions," AIAA Paper 84-0106, 1984.

9. Bragg, M. B., "Effect of Geometry on Airfoil Icing Characteristics,"Journal of Aircraft, Vol. 21, No. 7, July 1984.

10. Bragg, M. B. and Coirier, W. J., "Hot-Film Measurements of the Separation Bubble on an Airfoil with Glaze Ice," AIAA Paper 86-0484, 1986.

11. Bragg, M. B., Gregorek, G. M., and Lee, J. D., "Airfoil Aerodynamics in Icing Conditions," Journal of Aircraft, Vol. 23, No. 1, January 1986, pp. 76-81.

12. Bragg, M. B., Gregorek, G. M., and Shaw, R. J., "Wind Tunnel Investigation of Airfoil Performance Degradation Due to Icing," AIAA Paper No.82-0582, March 1982.

13. Bragg, M., Zaguli, R., and Gregorek, G., "Wind Tunnel Evaluation of Airfoil Performance Using Simulated Ice Shapes," NASA CR-167960, 1982.

14. Brumby, R. E., "Wing Surface Roughness, Cause and Effect," DC Flight Approach, January 1979.

15. Cooper, W. A., et al, "Effects of Icing on Performance of a Research Airplane," Journal of Aircraft, Vol. 21, No. 29, 1984, pp. 708-715.

16. Coppock, M. L. and Gerke, M. D., "Aircraft Gun Icing Evaluation,"RIA-R-TR-77-21, AD-A039-834/7SL, January 1977.

17. Core, Jr., C. M., "F-16 Ground and In Flight Icing Testing," Proc.Annual Symp., Soc. Flight Test Eng. 11th, Flight Test in the Eighties, Paper 3, 1980.

18. Cummings, S. C., "Aircraft Accidents in Which Ice Was a Factor - 1 January 1946 to 31 December 1958," USAF Directorate of Flight Safety Research, Unpublished Report, May 1959.

19. Flemming, R. J., Shaw, R. J., and Lee, J. D., "The Performance Characteristics of Simulated Ice on Rotorcraft Airfoils," 41st American Helicopter Society Forum, May 1985.

20. Frick, Jr., C. W. and McCullough, G. B., "Tests of a Heated Low Drag Airfoil ," NACA ACR, December 1942.

21. Geer, W. C., "An Analysis of the Problem of Ice on Airplanes," Journal of the Aeronautical Sciences, No. 6, pp. 451-459, 1939.

22. Gelder, T. F., Lewis, J. P., and Koutz, S. L., "Icing Protection for a Turbojet Transport Airplane: Heating Requirements, Methods of Protection and Performance Penalties," NACA TN 2866, January 1953.

23. Gray, V. H. and Von Glahn, U. H., "Effect of Ice and Frost Formations on Drag of NACA 65(1)-212 Airfoil for Various Modes of Thermal Ice Protection," NACA TN 2962, June 1953.

24. Gray, V, H. and Von Glahn, U. H., "Aerodynamic Effects Caused by Icing of an Unswept NACA 65A004 Airfoil ," NACA TN 4155, 1958.

25. Gray, V. H., "Correlation of Airfoil Ice Formations and Their Aerodynamic Effects with Impingement and Flight Conditions," Presented at the SAE National Aeronautics Meeting, September 30 - October 5, 1957, SAE Preprint No. 225.

26. Gray, V. H., "Correlations Among Ice Measurements, Impingement Rates, Icing Conditions and Drag Coefficients for an Unswept NACA 65A004 Airfoil," NACA TN 4151, 1958.

27. Gray, V. H., Prediction of Aerodynamic Penalties Caused by Ice Formations on Various Airfoils," NASA TN D-2166, February 1964.

28. Gregorek, G. M., Bragg, M. B., and Shilling, J. B., "Performance Analyses for Aircraft in Icing Conditions," AIAA Paper 84-0180, 1984.

29. Gulick, B. J., "Effect of a Simulated Ice Formation on the Aerodynamic Characteristics of an Airfoil," NACA WRL 292, 1938.

30. Hoschka, B. and Jesse, R. E., "Ice Accretion and Its Effects on Aerodynamics of Unprotected Aircraft Components," AGARD-AR-127, 1978.

31. Ingelman-Sandberg, M. and Trunov, O. K., "Wind Tunnel Investigation of the Hazardous Tail Stall Due to Icing," A Joint Report From the Swedish - Soviet Working Group on Flight Safety, Report No. JR-2, 1979.

32. Ingelman-Sundberg, M., Trunov, O. K., and Ivaniko, A., "Methods for Prediction of the Influence of Ice on Aircraft Flying Characteristics," Swedish-Soviet Working Group on Flight Safety, 6th Meeting, Report No.JR-1, 1977.

33. Jackson, G. C., "AEROICE: A Computer Program to Evaluate the Aerodynamic Penalties Due to Icing," Technical Memorandum AFFDL-79-91-WE, Air Force Flight Dynamics Laboratory, 1979.

34. Karlsen, L. K. and Salberg, A., "Digital Simulation of Aircraft Longitudinal Motions with Tailplane Ice," KTH Aero Report 55, Dept. of Aeronautics, The Royal Institute of Technology, Stockholm, Sweden, 1983.

35. Korkan, K. D., Cross, Jr., E. J., and Cornell, C. C., "Experimental Study of the Aerodynamic Characteristics of a NACA 0012 Airfoil with Simulated Ice," Texas A&M University, Texas.

36. Korkan, K. D., Cross, Jr., E. J., and Cornell, C. C., "Experimental Aerodynamic Characteristics of a NACA 0012 Airfoil with Simulated Ice," AIAA J. of Aircraft, Vol. 22, No. 2, February 1985.

37. Korkan, K. D., Dadone, L., and Shaw, R. J., "Performance Degradation of Propeller/Rotor Systems Due to Rime Ice Accretion," AIAA Paper No.82-0286, 1982.

38. Koutz, S. L., "Effect of Heat and Power Extraction on Turbojet-Engine Performance. IV - Analytical Determination of Effects of Hot-Gas Bleed," NACA TN 2304, 1951.

39. Koutz, S. L., Hensley, R. V., and Rom, F. E., "Effect of Heat and Power Extraction on Turbojet-Engine Performance. III - Analytical Determination of Effects of Shaft-Power Extraction," NACA TN 2202, 1950.

40. Laschka, B. and Jesse, R. E., "Ice Accretion and Its Effects on Aerodynamics of Unprotected Aircraft Components," AGARD Advisory Rep. No. 127, Paper 4, September 1977, Publ. 1978.

41. Laschka, B. and Jesse, R. E., "Determination of Ice Shapes and Their Effect on the Aerodynamic Characteristics of the Unprotected Tail of the A 300," Int. Counc. of the Aeronaut. Sci. (ICAS), 9th Cong. Proc., Vol.1, pp. 409-418, 1974.

42. Lee, J. D. and Shaw, R. J., "Aerodynamics of Rotor Blades with Ice Shapes Accreted in Hover and in Forward Flight, 41st American Helicopter Society Forum, May 1985.

43. Lee, J. D., "Aerodynamic Evaluation of a Helicopter Rotor Blade with Ice Accretion in Hover," AIAA Paper 84-0608, 1984.

44. Lewis, W. and Perkins, P. J., "A Flight Evaluation and Analysis of the Effect of Icing Conditions on the PG-2 Airship," NACA TN 4220, 1958.

45. Look, B. C., "Effect on the Performance of a Turbo-Supercharged Engine of an Exhaust-Gas-to-Air Heat Exchange for Thermal Ice-Prevention," NACA MR A5H23 (WR A-30), August 1945.

46. Mikkelsen, D. L., McKnight, R. C., Ranaudo, R. C., and Perkins, Jr., P., "Icing Flight Research: Aerodynamic Effects of Ice, and Ice Shape Documentation with Stereo Photography," AIAA Paper 85-0468, January 1985.

47. Mikkelsen, Kevin, Jahasz, Nikola, Ranaudo, Richard, McKnight, Robert, Freedman, Robert, and Greissing, John, "In-Flight Measurements of Wing Ice Shapes and Wing Section Drag Increases Caused by Natural Icing Conditions," NASA TM 87301, April 1986.

48. Miller, T., "Evaluation of Empirical Drag Coefficient Correlation Using NACA 0012, 65A004, and 632A415 Airfoil Icing Data," Sverdrup Technology, November 1985.

49. Miller, T. L., Korkan, K. D., and Shaw, R. J., "Statistical Study of an Airfoil Glaze Ice Drag Correlation," SAE Technical Paper 830753, 1983.

VIII.18.0 AIRFOIL AND AIRCRAFT PERFORMANCE DEGRIDATION (CONTINUED)

50. Miller, T. L., Korkan, K. D., and Shaw, R. J., "Analytical Determination of Propeller Performance Degradation Due to Ice Accretion," AIAA 85-0339, January 1985.

51. Miller, Thomas L., "Analytical Determination of Propeller Performance Degradation Due to Ice Accretion," NASA CR-175092, Prepared for Lewis Research Center Under Contract NAS 3-24105, April 1986.

52. Minsk, L. D., "Some Snow and Ice Properties Affecting VTOL Operation," AHS, AIAA, U. of Texas, Proc. of Joint Symp. on Environmental Effects on VTOL Designs, Arlington, Tx., November 16-18, 1970.

53. Morris, D. E., "Designing to Avoid Dangerous Behavior of an Aircraft Due to the Effects of Control Hinge Moments of Ice on the Leading Edge of the Fixed Surface," British Report, C. P. No. 66, Council, No. 10, 670, March 1947.

54. Murray, J. L., "Aircraft Operation in Natural Icing Conditions," U. S.Central Air Documents Office, Technical Data Digest, 14(24), pp. 12-18, December 15, 1949.

55. Olsen, W., Shaw, R. J., and Nowlan, J., "Ice Shapes and the Resulting Drag Increase for a NACA 0012 Airfoil ," NASA TM 83556, 1983.

56. Perkins, Porter, Characterizing Icing Encounters for Correlations with Aerodynamic Performance," Sverdrup Technology, Inc., Presented at University of Tennessee Space Institute, April 1984.

57. Perkins, Porter, "Coping With In-Flight Icing," Sverdrup Technology, Inc., Presented at 29th Corporate Aviation Seminar, Montreal, Canada, April 1-3, 1984.

58. Preston, C. M. and Blackman, C. D., "Effects of Ice Formation of Airplane Performance in Level Cruising Flight," NACA TN 1598, May 1948.

59. Ranaudo, R. J., Mikkelson, K. L., and McKnight, R. C., "Performance Degradation of a Typical Twin Engine Commuter Type Aircraft in Measured Natural Icing Conditions," AIAA Paper 84-0179, NASA TM 83564, January 1984.

60. Robinson, R. G., "The Drag of Inflatable Rubber De-Icers," NACA TN 669,October 1938.

61. Rodert, L. A. and Jones, A. R., "Profile-Drag Investigation of an Airplane Wing Equipped with Rubber Inflatable De-Icer," NACA Confidential Report, 1939.

62. Ruanado, R, J., Mikkelsen, K. L., McKnight, R. C., and Perkins, Jr., P.J., "Performance Degradation of a Typical Twin Engine Commuter Type Aircraft in Measured Natural Icing Conditions," NASA TM 83564 and AIAA-84-0179, 1984.

63. Selna, J., "An Investigation of a Thermal Ice-Prevention System for a C-46 Cargo Airplane.V.-Effect of Thermal System on Airplane Cruise Performance," NACA Wartime Report A-9, May 1945.(Also NACA ARR No.5D06, 1945.)

64. Shaw, R. J., "Experimental Determination of Airfoil Performance Degradation Due to Icing," AIAA Paper 84-0607, 1984.

65. Smith, Cpt. S., "The Hazards of Icing," Journal Aeronautical Sciences,February 1941.

66. Spence, A., "Further Wind Tunnel Tests on the Effects of Ice Accretion on Control Characteristics," RAE, TN No. AERO 2048, May 1950.

67. Sundberg, M., Trunov, O., and Ivaniko, A., "Methods for Prediction of the Influence of Ice on Aircraft Flying Characteristics," Report JR-1, Board of Civil Aviation, Sweden, 1977.

68. Teteryukov, A., "Flying Under Icing Conditions," Grazhdanskaya Aviatsiya,No. 2, pp. 12-15, 1955, (Transl. by USAF, Rept. IR 1006-55.)

69. Thomas, C. L., et al, "Icing Evaluation U-21A Airplane with Low Reflective Paint," USAAEFA-77-05, AD-A046-852, May 1, 1977.

70. Thompson, J. K., "Operation Analysis Techniques for Estimating the Effect of Deleting Aircraft Ice Protection Systems," WADC TN 59-163, AD-216-082, September 1959.

71. Thoren, R. L., "Icing Flight Tests of the Lockheed P2V," ASME, Paper No. 48-SA-41, 1948.

72. Trunov, O. K., "Certain Results of Experimental Test Flights Under Conditions of Icing," Transactions of GosNII GVF, Issue 19, 1957.

73. Trunov, O. K., "Landing in Icing Conditions," Civil Aviation, No. 1,1963.

74. Trunov, O. K., "The Danger in Ground Icing of Aircraft," Civil Aviation,No. 1, 1956.

75. Trunov, O. K., "Icing of Aircraft and Its Control," (Translation),Mashinostroyenie, 1965.

76. Trunov, O. K., "Results of Experimental Flights in Conditions of Icing Report on the International Conference on Problems of Icing," Redizdat, Aeroflot, 1960.

77. Trunov, O., "Winter - Landing Under Conditions of Ice Formation," (Translation) Foreign Tech. Div., FTD-HT-23-643-67, AD-674-335.

78. Trunov, O. K. and Ingelman-Sandberg, M., "On the Problem of Horizontal Tail Stall Due to Ice," A Joint Report from the Swedish-Soviet Working Group on Flight Safety, Report No. JR-3, 1985.

79. Von Glahn, U. H. and Gray, V. H., "Effect of Ice Formations on Section Drag of Swept NACA 63A-009 Airfoil with Partial-Span Leading-Edge Slat for Various Modes of Thermal Ice Protection," NACA RM E53J30, 1954.

80. Von Glahn, U. H., "Some Considerations of the Need for Icing Protection of High-Speed, High Altitude Airplanes," NACA Conference on Some Problems of Aircraft Operation, November 17-18, 1954, NACA Lecture 21, 1955.

81. Weber, W., "Aircraft Icing - Danger for Air Traffic," Aero-Revue, Vol. 39, pp. 662-665, November 1964.(In German.)

82. Wilder, R.W., "A Theoretical and Experimental Means to Predict Ice Accretion Shapes for Evaluating Aircraft Handling and Performance Characteristics," AGARD-AR-127, 1978, pp. 5-1 to 5-20.

83. Zaguli, R, J., "Potential Flow Analysis of Gaze Ice Accretions on an Airfoil," NASA CR-168282, January 1984.

84. Zaguli, R., Bragg, M. B., and Gregorek, G., "Results of an Experimental Program Investigating the Effects of Simulated Ice on the Performance of the NACA-63A415 Airfoil with Flap," NASA CR-168282, January 1984.

CHAPTER VIII

SECTION 19.0

ICE ADHESION AND MECHANICAL PROPERTIES

BIBLIOGRAPHY

VIII.19.0 ICE ADHESION AND MECHANICAL PROPERTIES

1. "A Study of Chemical-Physical Nature of Adhesion of Ice to Solid Surfaces," WADC Technical Report 53-461, October 1953.

2. "Adhesion and Shear Strength of Ice Frozen to Clean and Lubricated Surfaces," NRL Report 5832, August 30, 1962.

3. "Mechanical Measurement of Interatomic Bonding Energies at Interfaces," Journal of Material Science, London, England, Plenum Publishing Company, 1984.

4. Andrews, E. H. and Lockington, N. A., "The Cohesive and Adhesive Strength of Ice," Journal of Materials Science, Vol. 18, 1983.

5. Andrews, E. H., Majid, H. A., and Lockington, N. A., "Adhesion of Ice to a Flexible Substrate," Journal of Materials Science, Chapman and Hall, 1984.

6. Bernhart, W. D. and Zumwalt, G. W., "Electro-Impulse Deicing: Structural Dynamic Studies, Icing Tunnel Tests and Applications," AIAA Paper 84-0022, 1984.

7. Eskin, S. G., Fontain, W. D., and Witzell, O. W., "Strength Characteristics of Ice in Contact with Various Kinds of Surfaces," Purdue University, Refrigerating Engineering, December 1957.

8. Hawkes, I. and Mellor, M., "Deformation and Fracture of Ice Under Uniaxial Stress," U. S. Army Cold Regions Research and Engineering Laboratory, Journal of Glaciology, 172.

9. Itagaki, K., "Adhesion of Ice to Polymers and Other Surfaces," Physico-chemical Aspects of Polymer Surfaces, 1983, Vol. 1, pp. 241-252.

10. Itagaki, K., "The Implications of Surface Energy in Ice Adhesion,"Journal of Adhesion, 1983, Vol. 16, pp. 41-48.

11. Itagaki, K."Mechanical Ice Release Processes: Self-Shedding From High-Speed Rotors," CRREL Report 83-26, October 1983.

12. Jellinek, H. H. G., "Adhesive Properties of Ice," Research Report 38, U. S. Army Snow and Ice and Permafrost Research Establishment, September 1957.

13. List, R., "Ice Accretions on Structures," Journal of Glaciology, Vol. 19, No. 81, pp. 451-466, 1977.

14. Lange, M. A. and Ahrens, Thomas J., "The Dynamic Tensile Strength of Ice and Ice-Silicate Mixtures," Journal of Geophysical Research, Vol. 88, No. 82, February 10, 1983.

15. Lavrov, V. V., "Problems of the Physics and Mechanics of Ice," (Translation) Morskoy Transport, 1962.

16. Loughborough, D. L. and Hass, E. G., "Reduction of the Adhesion of Ice to De-Icer Surfaces," Journal of Aeronautical Sciences, Vol. 13, pp.126-134, March 1946.

17. Loughborough, D. L., "The Physics of the Mechanical Removal of Ice for Aircraft," Aero. Eng. Reivew, Vol. 11, No. 2, pp. 29-34, February 1952.

18. Meyer, W. R. and Foley, Jr., E. F., "Ice Adhesion Tests on Films of Organic Polar Materials," WADC Technical Report 56-591, March 1957.

19. Minsk, D. L., "Ice Adhesion Tests on Coatings Subject to Rain Erosion,"CRREL Special Report 80-28, July 1980.

20. Raraty, L. E. and Tabor, D., "The Adhesion and Strength Properties of Ice," Research Laboratory for the Physics and Chemistry of Surfaces, Department of Physical Chemistry, University of Cambridge, March 1957.

21. Raraty, L. E. and Tabor, D., "The Adhesion and Strength Properties of Ice," Proceedings of the Royal Society, Vol. A245, No. 1241, June 1958, pp. 184-201.

22. Rothrock, A. M. and Selden, R. F., "Adhesion of Ice in Its Relation to the De-Icing of Airplanes," NACA TN 723, August 1939.

23. Rush, C. K., "Ice Shedding Tests on a 10-foot Sharp-Edged Delta Wing at Low Angles of Attack," NRC Report LR-364, December 1962.

24. Sayward, J. M., "Seeking Low Ice Adhesion," CRREL Special Report 79-11,April 1979.

25. Scavuzzo, R. J. and Chu, M. L., "Structural Properties of Impact Ices Accreted on Aircraft Structures," NASA CR-179580, January 1987.

26. Scavuzzo, R. J., Chu, M. L., and Olsen, W. A., "Structural Properties of Impact Ices," AIAA-86-0549, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

27. Scavuzzo, R., "Presentation of Shear Test Data from NASA Icing Research Tunnel," University of Akron, Akron, Ohio, September 1984.

28. Simons, G. A., "Aerodynamic Shattering of Ice Crystals in Hypersonic Flight," AIAA Journal, Vol. 14, No. 11, pp. 1563-1570, November 1976.

29. Smith-Johannsen, R., "The "Peel Off" Mechanical Wing De-Icer," Basic Icing Research by General Electric Co., Fiscal Year 1946, U.S. Air Forces, Tech. Rept. 5539, 1947.

30. Smith, Johannsen R., "Effect of Impurities in Water on Ice Adhesion," Basic Icing Research by General Electric Co., Fiscal Year 1946, U.S. Air Forces, Tech. Rept. 5539, 1947.

31. Stahlberg, R., "Examination of the Rupture Mechanism of Ice and Wood,"Mater. Test. (Germany), 20(3), pp. 126-31, March 1978.

32. Stallabrass, J. R. and Price, R. D., "On The Adhesion of Ice to Various Materials," NRC Report LR-350, July 1962.

33. Stallabrass, J. R. and Price, R. D., "On the Adhesion of Ice to Various Materials," Canadian Aeronautics and Space Journal, Vol. 9, pp. 199-204, September 1963.

34. Tint, L. M., "Determination of Tensile and Shear Strength of Ice and Its Adhesion to Neoprene," Ames Aeronautical Laboratory, NACA, Moffet Field, California, June 18, 1943.

CHAPTER VIII

SECTION 20.0

HEAT TRANSFER

BIBLIOGRAPHY

VIII.20.0 HEAT TRANSFER

1. "Applications of Heating by Catalysis on Board Planes," (Translation)University of Michigan, Engineering Research Institute, January 1954.

2. "Calculations for a Thermal Anti-Icer," University of Michigan, Engineering Research Institute, October 1953.

3. "Ice Protection for Turbo-Jet Transport Airplane, Meteorological and Physics of Icing, Determination of Heat Requirements, Thermal Anti-Icing Systems for High-Speed Aircraft," SMF Fund Paper FF-1, Inst.Aero.Sciences, March 1950.

4. "Methods of Calculating Heat Conduction for Transient Aerodynamic Heating of Supersonic Wing Structures," Northrop Aircraft Company, Inc.

5. "Note on Kinetic Heating with Particular Reference to Conditions of Icing," Tech. Note No. 674, R.A.E., June 1942, (NACA Reprint, October 1942).

6. "Thermal Analysis of Wing Air Duct De-Icing System Cross Section for the DACo," Helmuth, Computer Engineering Associates, Inc., July 12, 1954 (Douglas P.O. T&M 2755ABC).

7. "Uniformly Conductive Surfaces," Project No., M992-4, University of Michigan Engineering Research Institute, Wright Air Development Center, U. S. Air Force Contract AF 18 (600)-51, E. O. No. 462 BR-1, September 1953.

8. Achenbach, E., "The Effect of Surface Roughness on the Heat Transfer from a Circular Cylinder to the Cross Flow of Air," Inst. J. Heat Mass Transfer, 20, 1977.

9. Anderson, B. H., "Improved Technique for Measuring Heat Transfer Coefficients," Planetary and Space Science, Vol. 4, No. 1, 1961.

10. Arimilli, R. V., Smith, M. E., and Keshock, E. G., "Measurements of Local Convective Heat Transfer Coefficients on Ice Accretion Shapes," AIAA Paper 84-0018, 1984.

11. Arpaci, "Conduction Heat Transfer," Addison-Wesley, Reading, Massachussetts, 1966.

12. Baliga, G., "Numerical Simulation of One-Dimensional Heat Transfer in Composite Bodies with Phase Change," M. Sc. Thesis, Univ. of Toledo, Toledo, Ohio, 1980.

13. Beckwith, I. E. and Gallagher, J. J., "Local Heat Transfer and Recovery Temperature on a Yawed Cylinder at Mach Numbers of 4 and 15, and High Reynolds Numbers," NASA TR R-104, 1961.

14. Berteirud, A., "Temperature Measurements on the Vickers Viscount Stabilizer in Flight Under Icing Conditions," FFAP-A-369, N79-15845/6, August 24, 1977.

15. Boelter, L. M. K. and Lockhart, R. W., "An Investigation of Aircraft Heaters. XXXV-Thermocouple Conduction Error Observed in Measuring Surface Temperature," NACA TN 2427, 1951.

16. Boelter, L. M. K., Grossman, L. M., Martinelli, R. C., and Morrin, E. H., "An Investigation of Aircraft Heaters.Part XXIX-Comparison of Several Methods of Calculating Heat Losses from Airfoils," University of California, NACA TN 1453, 1947.

17. Boelter, L. M. K., Martinelli, R. C., Romie, F. E., and Morrin, E. H., "An Investigation of Aircraft Heaters.XVIII-A Design Manual for ExhaustGas and Air Exchangers," NACA WR W-95, 1945.(Formerly NACA ARR 5A06.)

18. Boelter, L. M. K., Sanders, V. D., and Romie, F. E., "An Investigation of Aircraft Heaters.XXXVIII-Determination of Thermal Performance of Rectangular and Trapezoidal-Shaped Inner-Skin Passages," NACA TN 2524, 1951.

19. Bosvort, R. L., "Processes of Heat Transfer," (Translation) GITTL, 1957.

20. Brown, C. D. and Orr, J. L., "A Theoretical and Experimental Investigation of the Effects of Kinetic Heating on Ice Formation on Aircraft Propeller Blades," NRC Report MD-30, December 1946.

21. Brun, E., "Distribution of Temperature Over an Airplane Wing with Reference to the Phenomena of Ice Formation," NACA TM 883, 1938.

22. Bryant, L. W., Ower, E., Halliday, A. S., and Faulkner, V. M., "On the Convection of Heat From the Surface of an Aerofoil in a Wind Current," British A.R.C. R. and M. No. 1163, May 1928.

23. Callaghan, E. E. and Ruggeri, R. S., "A General Correlation of Temperature Profiles Downstream of a Heated Air Jet Directed Perpendicularly to an Airstream," NACA TN 2466, 1951.

24. Callaghan, E. E., "Analogy Between Mass and Heat Transfer with Turbulent Flow," NACA TN 3045, 1953.

25. Campbell, W. F., "A Rapid Analytical Method for Calculating the Early Transient Temperature in a Composite Slab," NRC Report MT-32, April 1956.

26. Cansdale, J. T., et al, "The Kinetic Temperature Recovery Factor Around the Surface of a Cylinder Transverse to an Airstream," RAE Technical Report 78008, January 1978.

27. Cansdale, J. T. and McNaughtan, I. I., "Calculation of Surface Temperature and Ice Accretion Rate in a Mixed Water Droplet/Ice Crystal Cloud," RAE Technical Report 77090, June 1977.

28. Carslaw, H. S. and Jaeger, J. C., "Conduction of Heat in Solids,"Clarendon Press, Oxford, 1959.

29. Chao, David F., "Numerical Simulation of Two-Dimensional Heat Transfer in Composite Bodies with Application to De-Icing of Aircraft Components," NASA CR-168283, November 1983.

30. Chia-S, Y., Cermak, J. E., and Shen, R. T., "Temperature Distribution in the Boundary Layer of an Airplane Wing with a Line Source of Heat at the Stagnation Edge - Symmetrical Wing in Symmetric Flow," Naval Research, Naval Dept., Washington, D. C., ASTIA AD-9799.

31. Coles, W. D. and Ruggeri, R. S., "Experimental Investigation of Sublimation of Ice at Subsonic and Supersonic Speeds and Its Relation to Heat Transfer," NACA TN 3104, 1954.

32. Coles, W. D., "Experimental Determination of Thermal Conductivity of Low-Density Ice," NACA TN 3143, 1954.

33. Cousins, H. M., Rich, B. R., and Smith, Jr., R. E., "Thermodynamics L-206 Medium Cargo Airplane," Report No. 7938. (Confidential)

34. Curle, N., "Heat Transfer Through a Constant-Property Laminar Boundary Layer," ARC R&M, No. 3300, 1962.

35. Darsow, J. F. and Selna, J., "A Flight Investigation of the Thermal Performance of an Air-Heated Propeller," NACA TN 1178, 1946.

36. DeWitt, K. J. and Baglia, G., "Numerical Simulation of One-Dimensional Heat Transfer in Composite Bodies with Phase Change," NASA CR-165607, March 1, 1982.

37. DeWitt, K. J., Keith, T. G., Chao, D. F., and Masiulaniec, K. C., "Numerical Simulation of Electrothermal De-Icing Systems," Paper No.AIAA-83-0114, AIAA 21st Aerospace Sciences Meeting, Reno, Nevada, January 1983.

38. Dickey, T. A., "The Influence of Runback on Local Energy Exchanges During Icing (A Preliminary Report of an Untested Theory Presented at the Project Summit Sprint Planning Conference)," Phil., Pa., Aero.Engr.Lab., Naval Air Materiel Center, May 1952.

39. Drake, Jr., R. M., Seban, R. A., Dought, D. L., and Levy, S., "Local Heat Transfer Coefficients on Surface of an Elliptical Cylinder, Axis Ratio 1:3, in a High-Speed Air Stream," Trans. A.S.M.E., Vol. 75, No. 7, pp.1291-1301, Discussion, pp.1301-1302, October 1953.

40. Drake, R. M., "Investigation of the Variation of Point Unit Heat Transfer Coefficients for Laminar Flow Over an Inclined Flat Plate," Journal of Applied Mechanics, Vol. 16, No. 1, 1949.

41. Dutt, M. and Stickney, T. M., "Thermal Recovery and the Accuracy of Air Total Temperature Sensors," Instrumentation in the Aerospace Industry, Volume 16 Instrument Society of America, Proc.of the 16th International Aerospace Instrumentation Symposium, Seattle, Washington, May 11-13, 1970.

42. Eckert, E. and Drewitz, O., "Calculation of the Temperature Field in the Laminar Boundary Layer of an Unheated Body in a High Speed Gas Flow," R.T.P. Trans. No. 1594, British M.A.P.

43. Fraser, D. and Rush, C. K., "Note on the Advantages of High Specific Power Inputs for Electrothermal De-Icing," NRC Report LR-149, September 1955.

44. Frick, Jr., C. W. and McCullough, G. B., "A Method for Determining the Rate of Heat Transfer From a Wing of Streamline Body," NACA Report 830, 1945.(Supersedes NACA ACR, December 1942.)

45. Fricke, C. L. and Smith, F. B., "Skin-Temperature Telemeter for Determining Boundary-Layer Heat-Transfer Coefficients," NACA RM L50J17, March 1951.

46. Fu-Kuo Chao, D., "Numerical Simulation of Two-Dimensional Heat Transfer in Composite Bodies Mth Application to De-Icing of Aircraft Components," The University of Toledo, Toledo, Ohio, NASA Lewis Research Center, November 1983.

47. Gelder, T. F., et al, "Icing Protection for a Turbojet Transport Airplane: Heating Requirements, Methods of Protection, and Performance Penalties," NACA TN 2866, 1953. 48.Gelder, T. F. and Lewis, J. P., "Comparison of Heat Transfer from Airfoil in Natural and Simulated Icing Conditions," NACA TN 2480, September 1951.

49. Gent, R. W. and Cansdale, J. T., "One Dimensional Treatment of Thermal Transients in Electrically De-Iced Helicopter Rotor Blades," RAE TR 80159, December 1980.

50. Giedt, W. H., "Investigation of Variation of Point Unit Heat Transfer Coefficients Around a Cylinder Normal to an Air Stream," Trans. of the ASME, Vol. 71, No. 4, 1949.

51. Goland, L., "The Theoretical Investigation of Heat Transfer in the Laminar Flow Regions of Airfoils," JAS, Vol. 17, No. 7, 1950.

52. Goss, J. K., "Electrically Heated Glove for Determining Local Values of Heat Transfer Coefficients," Northwest Airlines, Inc., MII 20-46, Paper No. 46-A-33, January 1947.

53. Gray, V. H. and Campbell, R. G., "A Method of Estimating Heat Requirements for Ice Prevention on Gas-Heated Hollow Propeller Blades," NACA TN 1494, 1947.

54. Gray, V. H. and Von Glahn, U. H., "Heat Requirements for Ice Protection of a Cyclically Gas-Heated, 36 Degree Swept Airfoil with Partial-Span Leading-Edge Slat," NACA RM E56B23, 1956.

55. Gray, V. H., "Improvements in Heat Transfer for Anti-Icing of Gas-Heated Airfoils with Internal Fins and Partitions," NACA TN 2126, 1950.

56. Gray, V. H., "Simple Graphical Solution of Heat Transfer and Evaporation from Surface Heated to Prevent Icing," NACA TN 2799, October 1952.

57. Gray, V. H., Bowden, D. T., and Von Glahn, U. H., "Preliminary Results of Cyclical De-Icing of a Gas-Heated Airfoil," NACA RM E51J29, 1952.

58. Greger, G. Erk, and Grigull, U., "Fundamentals of Heat Exchange," (Translation) IL, 1958.

59. Gurr, B., "Thermal Analyzer - Analysis Work for C-133A (Proposed Test Program)," January 12, 1954.

60. Hacker, P. T., et al, "Ice Protection for Turbojet Airplane.I-Meteorology and Physics of Icing.II-Determination of Heat Requirements.III-Thermal Anti-Icing Systems for High Speed Aircraft," Institute of Aeronautical Sciences, Special Publication No.FF-1, 1950.

61. Hardy, J. K. and Mann, G., "Prediction of the Rate of Formation of Ice and the Rate of Heating Necessary to Prevent Ice," Tech. Note No. Aero.1010, R.A.E., August 1942.

62. Hardy, J. K. and Morris, R., "Transfer of Heat Internally in a Heated Wing," Rep. No. Mech. Eng. 4, British R.A.E., January 1948.

63. Hardy, J. K., "Kinetic Temperature of Wet Surfaces, A Method of Calculating the Amount of Alcohol Required to Prevent Ice, and the Derivation of the Psychrometric Equation," NACA Wartime Report A-8, September 1945.(Formerly NACA ARR 5G13, 1945.)

64. Hardy, J. R., "An Analysis of the Dissipation of Heat in Conditions of Icing from a Section of the Wing of the C-46 Airplane," NACA Report No.831, 1946.

65. Hardy, J. R., "Kinetic Temperature of Propeller Blades in Conditions of Icing," ARC R&M, No. 2806, 1947.

66. Hardy, J. R., "Kinetic Temperature of Wet Surfaces," ARC R&M, No. 2830, 1945.

67. Harris, M. and Schlaff, B. A., "An Investigation of a Thermal Ice-Prevention System for a Cargo Airplane.VIII-Metallurgical Examination of the Wing Leading-Edge Structure After 225 Hours of Flight Operation of the Thermal System," NACA TN No. 1235, 1947.

68. Hauger, Jr., H. H. "Intermittent Heating of Airfoils for Ice Protection Utilizing Hot Air," Appendix F., M. S. Thesis, Univ. of California, Los Angeles, Dept. of Engr., 1953.

69. Hauger, Jr., H. H., "Intermittent Heating of Airfoil for Ice Protection,Utilizing Hot Air," Transactions of the ASME, Vol. 76, No. 2, 1954.

70. Jackson, R. G. and Graham, R., "The Effect of an Aircraft Wing Structure of De-Icing by Direct Application of Exhaust Gases-and Addendum," Thornton Res.Centre, England, January 1950.

71. Jackson, R., "An Investigation of a Thermal Ice-Prevention System for a C-46 Cargo Airplane.II-The Design, Construction, and Preliminary Tests of the Exhaust-Air Heat Exchanger," NACA ARR No.5AO3A, 1945.

72. Jakob, M. S., Kezios, C., Sinila, A., Sogin, H. H., and Speilman, M., "Aircraft Windshield Heat and Mass Transfer," Illinois Instl.of Technology, AF TR 6120, Part 5, June 1952.

73. Jakob, M., Kezios, S. P., Rose, R. L., Sogin, H. H., Spielman, M., Nakazato, S., and Sinila, A., "Aircraft Windshield Heat and Mass Transfer," AF Technical Report No. 6120, Illinois Institute of Technology, April 1950.

74. Johnson, H. A. and Rubesin, M. W., "Aerodynamic Heating and Convective Heat Transfer - Summary of Literature Survey," Trans.ASME, Vol. 71, No.5, pp. 447-456, July 1949.

75. Johnson, J. C., "Measurement of the Surface Temperature of Evaporating Water Drops," M.I.T., 270A, July 1949.

76. Jonas, J., "Thermal Fin Effects in Heat Anti-Icing Corrugations," Aero-nautical Engineer, Northrop Aircraft Co., RP-1147, October 1947.

77. Jones, A. R., Holdaway, G. H., and Steinmetz, C. P., "A Method for Calculating the Heat Required for Windshield Thermal Ice Prevention Based on Extensive Flight Tests in Natural-Icing Conditions," NACA TN 1434, 1947.

78. Kantrowitz, A., "Aerodynamic Heating and the Deflection of Drops by an Obstacle on an Air Stream in Relation to Aircraft Icing," NACA TN 779, October 1940.

79. Kennedy, L. A. and Goodman, J., "Free Convection Heat and Mass Transfer Under Conditions of Free Deposition," September 4, 1973.

80. Klein, J. K. and Tribus, M., "Forced Convection from Non-Isothermal Surfaces," Project M-992-B, University of Michigan, Engineering Research Institute, August 1952.

81. Klein, J. S. and Corcos, G., "A Note on the Heat Required for Thermal De-Icing," Engineering Res. Instl., Univ. of Michigan, May 1952.

82. Kleinknecht, K. S., "Flight Investigation of the Heat Requirements for Ice Prevention on Aircraft Windshields," NACA RM E7G28, September 1947.

83. Knuth, E. L., "Comments on Flight Measurements of Aerodynamic Heating and Boundary Layer Transition on the Viking Nose Cone," Jet Propulsion, Vol.26, No. 12, 1956.

84. Koh, J. C. J. and Barnett, J. P,, "Measured Pressure Distribution and Local Heat Transfer Rates for Flow Over Concave Hemisphere," ARS Paper 11460-60, 1960.

85. Kushnick, J. L., "Thermodynamic Design of Double-Panel, Air-Heated Wind-shields for Ice Prevention," NACA RB No. 3F24, 1943.

86. Langmuir, I., "The Cooling of Cylinders by Fog Moving at High Velocities," General Electric Research Laboratories, March 1945.

87. Larson, R. W., "Evaluation of the Wing and Empennage 600,000 BTU Anti- Icing Heater Installation for the C-124 Type Airplane. Vols. I and II," Douglas Aircraft, Testing Division, Rept. No. DEV.-1020, February 1953.

88. Ledford, R. L., "A Device for Measuring Heat Transfer Rates in Hypervelocity Wind Tunnels," Advances in Hypervelocity Techniques, New York, 1962.

89. Leffel, Kevin L., "A Numerical and Experimental Investigation of Electro-thermal Aircraft De-Icing," NASA CR 175024, Prepared for Lewis Research Center Under Grant NAG 3-72, January 1986.

90. Lewis, J. P. and Ruggeri, R. S., "An Investigation of Heat Transfer from a Stationary and Rotating Ellipsoidal Forebody of Fineness Ratio 3," NACA TN 3837, 1956.

91. Lewis, J. P., "An Analytical Study of Heat Requirements for Icing Protection of Radomes," NACA RM E53A22, 1953.

92. Liebmann, G., "Solution of Transient Heat-Transfer Problem by the Resistance-Network Analog Method," Trans. of the ASME, Vol. 78, No. 6, 1956.

93. Lin, Ts., "Turbulent Flow and Heat Transfer," (Translation) IL, 1963.

94. Ludlam, F. H., "The Heat Economy of a Rimed Cylinder," Quarterly Jour. Royal Met. Soc., Vol. 77, No. 334, pp. 663, 1951.

95. Marano, J. J., "Numerical Simulation of an Electrothermal Deicer Pad,"NASA CR-168097.

96. Martinelli, R. C., Guibert, A. G., Morrin, E. H., and Boelter, L. M. K., "An Investigation of Aircraft Heaters. VIII - A Simplified Method for the Calculation of the Unit Thermal Conductance Over Wings," NACA WR W-14, 1943.(Formerly NACA ARR, March 1943.)

97. Martinelli, R. C., Tribus, M., and Boelter, L. M. K., "An Investigation of Aircraft Heaters. I - Elementary Heat Transfer Considerations in an Airplane," NACA ARK (WR-23), Oct. 1942.

98. Masiulaniec, K. K., Keith, T. G., DeWitt, K. J., and Leffel, K., "Full Two-Dimensional Transient Solutions of Electrothermal Aircraft Blade Deicing," AIAA Paper 85-0413, 1985.

99. Messinger, B. L., "Equilibrium Temperature of an Unheated Icing Surface as a Function of Air Speed," Jour. Aero. Sci., Vol. 20, No. 1, pp. 29-42, January 1953.

100. Messinger, B. L., "Energy Exchanger During Icing," Airplane Icing Information Course, Univ. of Michigan Lecture 6, 1953.

101. Morrin, E. H., "Notes on Predicting Heat Anti-Icing System," Prepared by University of California, for Air Tech.Service Command, June 9, 1945.

102. Naiman, J. M., "Basic Principles Used in the Design of the Thermal Anti-Icing System of the DC-6 Airfoils," Douglas Aircraft Co., Rept. No.Sm-11911, 1946.

103. Neel, Jr., C. B., "An Investigation of a Thermal Ice-Prevention System for a C-46 Cargo Airplane.I-Analysis of the Thermal Design for Wings, Empennage and Windshield," NACA Wartime Report A-52, February 1945.

104. Neel, Jr., C. B., "Calculation of Heat Required for Wing Thermal Ice Prevention in Specified Icing Conditions," SAE Quart. Trans., Vol. 2, No. 3, pp. 369-378, July 1948.

105. Neel, Jr., C. B., Bergrun, N. R., Jukoff, D., and Schlaff, B. A., "The Calculation of the Heat Required for Wing Thermal Ice Prevention in Specified Icing Conditions," NACA TN 1472, December 1947.

106. Ockenden, J. R. and Hodgkins, W. R., (editors), "Moving Boundary VaueProblems in Heat Flow and Diffusion," Oxford Univ.Press, Oxford, 1975.

107. Orr, J. L., "General Specifications for N.R.C. Type W7-1 Heating Pads for Electro-Thermal Wing De-Icing," Nat. Res. Council, Canada, Lt. Memo 5902-1, June 1950.

108. Patterson, D. M., "A Simplified Procedure for the Determination of Heat Requirements for Ice Protection of Fixed Areas of Aircraft," Technical Data Digest (Central Air Documents Office), February 15, 1949.

109. Payne, E., "Heat Transfer Applied to Aircraft Turbojet Engines," World Aerospace Systems, Vol. 2, pp. 158-160, April 1966.

110. Pearls, T. A. and Hartog, S. S., "Pyroelectric Transducers for Heat Transfer Measurements," Acta IMEKO, Budapest, Vol. 4, 1961.

111. Peterson, A. A., "Composite Rotor De-Icing Thermal Analysis," Boeing Vertol Report D210-12252-1, September 1983.

112. Peterson, Andrew A., "Thermal Analysis Techniques for Design of VSTOL Aircraft Rotor Ice Protection," AIAA 23rd Aerospace Sciences Meeting, Reno, Nevada, Report AIAA-85-0340, 1985.

113. Petukhov, B. S., "Experilnental Study of Heat Transfer Processes," (Translation) Moscow-Leningrad, Gosenergoizdat, 1962.

114. Preobrazhenskiy, V. P., "Heat-Engineering Measurements and Instruments,"(Translation) Gosenergoizdat, 1946.

115. Robinson, H. G., "An Analogue Computer for Convective Heating Problems,"A.R.C. Technical Report C. P., No. 374, 1957.

116. Rodert, L. A. and Clousing, L. A., "A Flight Investigation of the Thermal Properties of an Exhaust-Heated-Wing De-Icing System on a Lockheed 12-A Airplane. (Supplement No. 1)," NACA ARR, July 1941.

117. Rodert, L. A. and Clousing, L. A., "A Flight Investigation of the Thermal Properties of an Exhaust-Heated-Wing De-Icing System on a Lockheed 12-A Airplane. (Supplement No. 2)," NACA ARR, April 1941.

118. Rodert, L. A. and Clousing, L. A., "A Flight Investigation of the Thermal Properties of an Exhaust-Heated-Wing De-Icing System on a Lockheed 12-A Airplane," NACA Wartime Report A-45, ARR, June 1941.

119. Ross, R., "Thermodynamic Performance of an Airplane Wing Leading Edge Anti-Icing System," Ross Aviation Associates, AIAA, February 3, 1984.

120. Ruggeri, R. S. and Lewis, J. P., "Investigation of Heat Transfer from a Stationary and Rotating Conical Forebody," NACA TN 4093, 1957.

121. Schaefer, V. J., "Heat Requirements for Instruments and Airfoils During Icing Storms of Mt. Washington," Trans. of the ASME, Vol. 69, No. 8, 1947.

122. Seban, R. A. and Bond, R., "Skin-Friction and Heat Transfer Characteristics of a Laminar Boundary Layer on a Cylinder in Axial Incompressible Flow," JAS, Vol. 18, No. 10, 1951.

123. Seban, R. A. and Drake, R. M., "Local Heat Transfer Coefficients on the Surface of an Elliptical Cylinder in a High Speed Stream," Trans. of the ASME, Vol. 75, No. 2, 1953.

124. Selna, J. and Kees, H. L., "An Investigation of a Thermal Ice-Prevention System for a C-46 Cargo Airplane.VI-Dry-Air Performance of Thermal System at Several Twin and Single-Engine Operating Conditions at Various Altitudes," NACA ARR No. 5C20, 1945.

125. Selna, J. and Zerbe, J. E., "A Method for Calculating the Heat Required for the Prevention of Fog Formations on the Inside Surfaces of Single-Panel Bullet-Resisting Windshields During Diving Flight," NACA TN 1301, July 1947.

126. Smith, M. E., Arimilli, R. V., and Keshock, E. G., "Measurement of Local Convective Heat Transfer Coefficients of Four Ice Accretion Shapes," University of Tennessee, NASA Contractor Report 174680, May 1984.

127. Squire, H. B., "Heat Transfer Calculation for Aerofoils," NACA MRR No. 3E29, 1943.

128. Squire, H. B., "Heat Transfer Calculation for Airfoils," ARC R & M No. 1986, 1942.

129. Stallabrass, J. R., "Thermal Aspects of De-Icer Design," Presented at the International Helicopter Icing Conference, Ottawa, May 23-25, 1972.

130. Tang, Y. S., Duncan, H. M., and Schweyer, H. E., "Heat and Momentum Transfer Between a Spherical Particle and Air Streams," NACA TN 2867, March 1953.

131. Theodorsen, T. and Clay, W. C., "Ice Prevention on Aircraft by Means of Engine Exhaust Heat and a Technical Study of Heat Transmission from a Clark Y Airfoil," NACA TR 403, June 1931.

132. Torgeson, W. L. and Abramson, A. E., "A Study of Heat Requirements for Anti-Icins Radome Shapes with Dry and Wet Surfaces," WADC Tech. Rep.53-284, Wright Air Dev. Center, Wright-Patterson Air Force Base, September 1953. (Contract AF 33(616)-85, RDO No. 664-802.)

133. Tribus, M., Young, G. B., and Boelter, L. M. K., "Analysis of Heat Transfer over a Small Cylinder in Icing Conditions on Mt.Washington," Trans.ASME, Vol. 70, No. 8, 1948, pp. 871-876.

134. Trunov, O. K. and Egorov, M. S., "Some Results of Experimental Flights in Natural Icing Conditions and Operation of Aircraft Thermal Ice-Protection Systems," (Translation) National Research Inst.for Civil Air Fleet, USSR, 1957.

135. Van Fossen, G. J., Simoneau, R. J., Olsen, Jr., W. A., and Shaw, R. J., "Heat Transfer Distributions Around Nominal Ice Accretion Shapes Formed on a Cylinder in the NASA Lewis Research Tunnel ," AIAA Paper 84-0017, January 1984.

136. Von Glahn, U. H., "Preliminary Results of Heat Transfer from a Stationary and Rotating Ellipsoidal Spinner," NACA RM E53F02, 1953.

137. Wardlaw, R. L., "An Approximate Method for Estimating the Transient Heat Flow Distribution on a De-Icing Pad," NRC Report LR-95, January 1954.

138. Wardlow, R. L., "An Approximate method for Estimation of the Heat Distribution in an Intermittently Heated De-Icing Pad," NAE, Canada, 1953.

139. Weaver, J. H. and Wade, D. K., "Thermal Flux Protection for Aircraft," Air Force Materials Laboratory, Wright-Patterson Air Force Base.

140. Weiner, F. R., "Calculation of Surface Heat Requirements for Anti-Icing the Wings and Empennage of a Hypothetical Airplane," Consolidated Vultee Aircraft Corp., San Diego Div., September 1950.

141. Werner, J. F.and Freidlander, M. M., "A Simplified Graphical Method for Determining the Heat and Air Flow Required for Anti-Icing," Appendix I, Report No. 853D, Lockheed Aircraft Corporation, ASTIA - ATI-159-453, April 15, 1952.

142. Xanarkis, G., Amerman, A. E., and Michelson, R. W., "An Investigation of the Heat-Transfer Characteristics of Spheres in Forced Convection," W.A.D.C.Technical Report 53-117, Ypsilanti, Michigan, Smith, Hinchman and Grylls, Inc., Aeronautical Icing Research Lab., 1953.

143. Yeoman, K. E., "Finite Element Thermal Analysis of an Icing Protective System," AIAA-83-0113, January 1983.

CHAPTER VIII

SECTION 21.0

FLUID FLOW DYNAMICS

BIBLIOGRAPHY

VIII.21.0 FLUID FLOW DYNAMICS

1. "Theory and Operation of Electrical Analog for Potential Flows," A250-AER0-56-52, January 20, 1956.

2. Baldwin, B. S. and Lomax, H., "Thin Layer Approximation and Algebraic Model for Separated Turbulent Flows," AIAA Paper 78-257, Jan. 1978.

3. Bauer, F., Garabedian, G,, and Korn, D., "A Theory of Supercritical Wing Sections with Computer Programs and Examples," Lecture Notes in Economical and Mathematical Systems, Springer-Verlag, New York, 1972.

4. Beam, R. M. and Warming, R. F., "An Implicit Factored Scheme for the Compressible Navier-Stokes Equations," AIAA Journal Vol. 16, No. 4, April 1978, pp. 393-402.

5. Boerner, Th. and Leutheusser, H. J., "Calibration of Split-Fibre Probe for Use in Bubbly Two-Phase Flow," DISA Information, No.29, January 1984.

6. Brandt, A., "Multilevel Adaptive Computations in Fluid Dynamics," AIAA Journal, Vol. 18, October 1980, pp. 1165-1172.

7. Cebeci, T., "Calculation of Compressible Turbulent Boundary Layers with Heat and Mass Transfer," AIAA Journal, Vol. 9, ,June 1971, pp. 1091-1097.

8. Davies, C. N., "Definitive Equations for the Fluid Resistance of Spheres," Proc. Phys. Soc. London, Vol. 57, 1945, pp. 259-270.

9. Dryden, H. L., "Review of Published Data on the Effect of Roughness on Transition from Laminar to Turbulent Flow," Jour.Aero.Sci., Vol.20, No. 7, pp. 477-482, July 1953.

10. Gauvin, W. H., "Fundamental Aspects of Solid-Gas Flow," Can.Journal of Chem. Eng., 37, pp. 129-141, 1959.

11. Gol'dshteyn, S., "Present Status of Hydrodynamics of Viscous Fluid,"(Translation) Volume I and II, IL.1948.

12. Grashof,J."Investigation of the Three Dimensional Transonic Flow Around an Air Intake by a Finite Volume Method for the Euler Equations," Recent Contributions to Fluid Mechanics, Edited by W.Haase, Springer-Verlag, 1982.

13. Hess, J. L. and Martin, R. P., Jr., "Improved Solution for Potential Flow About Axisymmetric Bodies by the Use of a Higher-Order Surface Source Method, Part 1 Theory and Results - The Parabolic - Element Linear Source Method," NASA CR-134694, 1974.

14. Hess, J. L. and Smith, A. M. O., "Calculation of Non-Lifting Potential Flow About Arbitrary Three-Dimensional Bodies," McDonnell Douglas Report E.S.40622, AD-282-255, March 1962.

15. Hess, J. L. and Smith, A. M. O., "Calculation of Potential Flow About Arbitrary Bodies," Progress in Aeronautical Sciences, Vol.8, New York, D.Kuchemann, Pergamon Press.1967.

16. Hess, J. L., "Calculation of Potential Flow About Arbitrary Three-Dimensional Lifting Bodies," Report No. MDC J5679-01, AD-755-480, October 1972.

17. Hess, J. L., "Calculation of Compressible Flow In and About Three-Dimensional Inlets by Higher Order Panel Methods," NASA CR 168009, 1982.

18. Jamison, A. and Caughey, D. A., "Numerical Calculation of the Transonic Flow Past a Swept Wing," New York University, ERDA Report C00-3077-140, 1977.

19. Kapitsa, P. L."Wave Flow of Thin Layers of Viscous Liquid," ShETF AN SSSR (Journal of Experimental and Technical Physics, USSR Academy of Sciences) Vol. 18, No. 1, 1948.

20. Keim, S. R., "Fluid Resistance to Cylinders in Accelerated Motion," Paper 1113, J. Hydraulics Div., Proc. Amer. Soc. Civil Eng., Vol. 6, 1956.

21. Lieblein, S. and Stockman, N. O., "Compressibility Correction for Internal Flow Solutions," Journal of Aircraft, Vol. 9, No. 4, April 1972, pp. 157-163.

22. Liu, T. M. and Schaefer, R. W., "A Comparative Study of Computer Codes for Flow Field Calculation of Nacelle Inlets," AIAA-86-0397, Rohr Industries, Inc., AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986, Reno, Nevada.

23. Mach, D-P., "Calculation of Potential Flow About Arbitrary Three-Dimensional Lifting Bodies," Users Manual, Report No.MDC J5679-02, AD-755- 933, October 1972.

24. McCarthy, D. R. and Reyhner, T. A., "Multigrid Code for Three-Dimensional Transonic Potential Flow About Inlets," AIAA Journal, Vol. 20, January 1982, pp. 45-50.

25. Naiman, J. M., "A New Method for Detrmining the Inside Air Flow Distribution for the Thermal Anti-Icing of an Airfoil Surface," McDonnell Douglas Corporation Icing Reports, April 11, 1946.

26. Norment, H. G. and Zalosh, R. G., "Effects of Airplane Flow Fields on Hydrometeor Concentration Measurements," December 6, 1979.

27. Norment, H. G., "Calculation of Water Drop Trajectories To and About Arbitrary Three-Dimensional Lifting and Nonlifting Bodies in Potential Flow," NASA Contractor Report 3935, Contract NAS3-22146, October 1985.

28. Norment, H. G., "Calculation of Water Drop Trajectories To and About Arbitrary Three-Dimensional Bodies in Potential Airflow," NASA CR-3291, August 1980.

29. Norment, H., "Effects of Airplane Flow Fields on Hydrometeor Concentration Measurements," Final Report AFCRL-TR-74-0602, December 1974.

30. Peyret, R. and Viviland, H., "Computation of Viscous Compressible Flows Based on the Navier-Stokes Equations," AGARD-AG-212, 1975.

31. Potapczuk, M. G. and Gerhart, P. M., "Evaluation of Iced Airfoil Performance Using a Navier-Stokes Equation Solver with a Body-Fitted Curvilinear Coordinate System," AIAA Paper 84-0107, 1984.

32. Potapczuk, M. G. and Gerhart, P. M., "Progress in Development of a Navier-Stokes Solver for Evaluation of Iced Airfoil Performance," AIAA Paper 85-0410, 1985.

33. Putnam, A., "Integrable Form of Droplet Drag Coefficient," ARS Journal,31, pp. 1467-1468 1961.

34. Reyhner, T. A., "Transonic Potential Flow Computation About Three-Dimensional Inlets, Ducts, and Bodies," AIAA Journal, Vol. 19, September 1981, pp. 1121-1122.

35. Reyhner, T. A., "Computation of Transonic Potential Flow About Three Dimensional Inlets, Ducts, and Bodies," NASA CR-3514 (Boeing Document D6-49848), March 1982.

36. Reyhner, T. A., "Three-Dimensional Transonic Potential Flow About Complex Three-Dimensional Configurations," NASA CR 3814, 1984.

37. Rudinger, G., "Fundamentals of Gas-Particle Flow," Elsevier Scientific Publishing Company, 1980, pp. 7-12.

38. Schlichting, Hermann, "Boundary-Layer Theory," McGraw-Hill, 1979.

39. Sears, W. R., "Small Perturbation Theory in High Speed Aerodynamics and Jet Propulsion. Vol. VI. General Theory of High Speed Aerodynamics," Princeton University Press, 1954.

40. Shlikhting, G., "Inception of Turbulence," (Translation) IL, 1962.

41. Sorenson, R. L., "A Computer Program to Generate Two-Dimensional Grids About Airfoils and Other Shapes by the Use of Poisson's Equation," NASA TM-81198, 1980.

42. Steger, J. L., "Implicit Finite-Difference Simulation of Flow About Arbitrary Two-Dimensional Geometries," AIAA Journal, Vol. 16, No. 7, July 1978, pp. 679-686.

43. Strash, D. J., Nathman, J. K., Maskew, B., and Dvorak, F. A., "The Application of a Low-Order Panel Method - Program VSAERO - to Powerplant and Airframe Flow Studies," AIAA Paper No. 84-2178, August 1984.

44. Stockman, N. O. and Farrel, Jr., C. A., "Improved Computer Program for Calculating Potential Flow in Propulsion System Inlet," NASA TM 73728, July 1977.

45. Tabakoff, W. and Sugiyama, Y., "Experimental Method of Determining Particle Restitution Coefficients," Symposium on Polyphase Flow and Transient Technology Proceedings, 1980.

46. Zaguli, R. J., "Potential Flow Analysis of Glaze Ice Accretions on an Airfoil," NASA CR-168282, Jan.1, 1984.

CHAPTER VIII

SECTION 22.0

EVAPORATION, SUBLIMATION, AND CRYSTALLIZATION

BIBLIOGRAPHY

VIII.22.0 EVAPORATION, SUBLIMATION, AND CRYSTALLIZATION

1. Allen, R. A., "Minutes of Meeting Regarding Icing Research at Mount Washington, N. H.," U. S. Weather Bureau, Washington, 1945.

2. Altberg, V. Ia., "Regarding the Centers of Crystallization of Water," (Translation) Glavnaia Geofizica Observatoriia, Izvestiia, No.2, pp.3-10, 1929.

3. Altberg, W. and Lavrov, W., "Experiments on the Crystallization of Water.II," (Translation) Acta Physicochim, U.R.S.S., 11, pp. 287-290, 1939.

4. Altberg, W. and Lavrov, W., "Experiments on the Crystallization of Water. III," (Translation) Acta Physicochim, U.R.S.S., 13, pp. 725-729, 1940.

5. Altberg, W. J., "Crystalization Nuclei in Water," (Translation) Acta Physicochim, U.R.S.S., No. 8, pp. 677-678, 1938.

6. Averbakh, K. O., Goldin, G. S., Shor, G. S., and Smirnov, O. K., "Methods of Preventing the Formation of Ice Crystals in Fuels," Chem.and Technol.of Fuels and Lubricants, pp.8-18, June 30, 1965.

7. Ballard, O. R. and Quan, B., "Ice Crystals - a New Icing Hazard,"Canadian Aeronautical Journal, Vol. 4, No.1, January 1958.

8. Bespalova, E. A., Rabinovich, Uy, I., Sharkov, E. A., Shiryaeva, T. A., and Etkin, V. S., "Study of the Process of Ice Formation Based on Aircraft Measurements of Radiothermal Emission," Sov. Meteorol. Hydrol., No. 2, pp. 54-57, 1976.

9. Coles, W. D. and Ruggeri, R. S., "Experimental Investigation of Sublimation of Ice at Subsonic and Supersonic Speeds and Its Relation to Heat Transfer," NACA TN 3104, 1954.

10. Feniger, K., "Study of the Transmission of Cold by Natural Convection and the Formation of Rime," France, Centre National de la Recherche Scientifique, Journal des Recherches, No. 8, pp. 248-265, 1949.

11. Frank, F. C., "Molecular Structure of Deeply Supercooled Water," Nature,157, March 1956.

12. Fuchs, N., "Concerning the Velocity of Evaporation of Small Droplets in aGas Atmosphere," NACA JM 1160, Aug. 1947.

13. Hardy, J. K., "Evaporation of Drops of Liquid," RAE Report Mech. Eng. 1, 1947.

14. Howell, W. E., "Experiments in the Nucleation of Clouds with Dry Ice," Harvard-Mt. Washington Icing Research Report 1946-1947, U.S. Air Materiel Command, Tech. Rep. No. 5676.

15. Jellinek, H. H. G., "Liquid-Like (Transition) Layer on Ice," Departmentof Chemistry, Clarkson College of Technology," August 1, 1966.

16. Levine, J., "Statistical Explanation of Spontaneous Freezing Water Droplets," NACA TN 2234, 1950.

17. Lofgren, Gary and Weeks, W. F., "Effects of Growth Parameters on SubStructure Spacing in NaCl Ice Crystals," Journal of Glaciology, Vol.8, No. 52, 1969.

18. Lowe, P. R., "An Approximate Polynomial for the Computation of Saturation Vapor Pressure," J. Applied Meteorology, Vol. 16, January 1977.

19. Lowel, H. H., "Maximum Evaporation Rates of Water Droplets Approaching Obstacles in the Atmosphere," NACA TN 3024, 1953.

20. Mason, B. J., "The Nature of Ice-Forming Nuclei in the Atmosphere," Royal Meteorological Society, Quarterly Journal, No. 76, pp. 59-74, January 1950.

21. Marek, J. C., "Studies of Water Droplet Crystallization for the NASA-Lewis Icing Spray Nozzle," AIAA-86-0289, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

22. Miyamoto, S., "A Theory of the Rate of Sublimation," Trans. Faraday Soc.,29, pp. 794-797, July 1933.

23. Mossop, S. C. and Bigg, E. K., "The Freezing of Cloud Droplets," Proc. Phys. Soc., B., 66, 1953, Quarterly J. R. M. S., 80, No. 345, 1954.

24. Nakaya, U., Sato, I., and Sekido, Y., "Preliminary Experiments of the Artificial Production of Snow Crystals.Investigations on Snow," Journal of Faculty Science, Hokkaido Imperial Univ., Ser. II, No. 10, 2: 1-11, March 1953.

25. Plyler, E. K., "The Growth of Ice Crystals," Journal Geology, 34, pp. 58-64, Jan.-Feb. 1926.

26. Rangno, A. L., et al, "Production of Ice Particles in Clouds Due to Aircraft," American Meteorological Society, Nov. 9, 1982.

27. Ryan, B. F., "The Growth Rates and Densities of Ice Crystals Between -3 Degrees C and -21 Degrees C," CSIRO, Jan. 5, 1976.

28. Schaefer, V. J., "The Production of Ice Crystals in a Cloud of Super-cooled Water Droplets," Science, 104, pp. 457-459, Nov. 1946.

29. Schaefer, V. J., "The Occurrence of Ice Crystal Nuclei in the Free Atmosphere," General Electric Co., Occasional Report No. 20, Rept. No. RL-308, January 1950.

30. Schaller, R. C., et al, "A Survey of Melting Layer Research," AFGL-TR-82-0007, AD-A114-224, Jan. 4, 1982.

31. Schwerdtfeger, W., "Comparison of Formation of Ice and Water Particles," Mt. Washington Observatory Monthly Res. Bulletin, Vol. II, No. 8, Aug.1946.

32. Schwerdtfeger, W., "Comparison of the Conditions for the Formation of Water Drops and Ice Particles," (Translation) Harvard-Mt.Washington Icing Research Report 1946-1947, U.S.Air Materiel Command, Tech.Rept.5676.

33. Smith, R.-Johannsen, "Some Experiments on the Freezing of Water," General Electric Co., Occasional Report No.3, Jun 1948.

34. Thompson, J. K., "High Airspeed Ice Removal and Sublimation Capability,"WADC Tech. Note 58-19, AD-142-292, March 1958.

35. Tribus, M., Klein, J. S., and Remboski, J., "A Method for Calculating the Rate of Evaporation and the Change in Drop Size Distribution for Pure Sprays Injected into Unsaturated Air," Project M992-C, University of Michigan, Engineering Research Institute, May 1952.

36. Ubbelohde, A. R., "Metastable Forms of Ice Produced by Super-Cooled Water," Nature, 157, pp. 625, May 1946.

37. Veinberg, V. P. "On the Degree of Correspondence Between This Experimental Data and the View Point of Prof.Al'berg on the Crystallization Processes of Supercooled Water," (Translation) Meteorologiia i Gidrologiia, No. 9, pp. 3-20, 1939.

38. Vonnegut, B., "Production of Ice Crystals by the Adiabatic Expansion of Gas: Nucleation of Supercooled Water Clouds by Silver Iodide Smokes: Influence of Butyl Alcohol on Shape of Snow Crystals Formed in the Laboratory," General Electric Co., Occasional Report No.5, July 1948.

39. Weickmann, H., "Experimental Investigations in Formation of Ice and water Nuclei at Low Temperatures; Inferences Regarding the Growth of Atmospheric Ice Crystals," (Translation) Harvard-Mt.Washington Icing Research Report 1946-1947, U.S. Air Materiel Command, Tech. Rept. 5676.

40. Young, S. W. and VanSicklen, W. J., "The Mechanical Stimulus of Crystallization," Journal American Chemical Soc., 35, pp. 1067-1078, Sept.1913.

41. Young, S. W., "Mechanical Stimulus to Crystallization in Supercooled Liquids," Journal American Chemical Soc., 33, pp. 148-162, Feb. 1911.

CHAPTER VIII

SECTION 23.0

EDUCATION, TRAINING, AND MISCELLANEOUS

BIBLIOGRAPHY

VIII.23.0 EDUCATION, TRAINING, AND MISCELLANEOUS

1. "Advisory Circular Checklist," U.S. Department of Transportation, Federal Aviation Administration, AC 00-222, October 15, 1986.

2. "Aerographer's Mate 1 and C," Naval Education and Training Support Command Manual No.NAVEDTRA 10362-B, Government Printing Office, Washington, D.C., 1974.

3. "Aircraft Accidents - Method of Analysis," Committee on Aircraft Accidents, NACA Rept. 576, 1936.

4. "Aircraft Ice Protection," FAA Advisory Circular AC No.20-73, April 21,1971.

5. "Aircraft Icing Technology of the SAE Aircraft Division," Meeting No. 2 of SAE Subcommittee AC-9C, May 7, 1985.

6. "Aircraft Systems," Aircraft Engineering, Vol. 37, pp. 17-21, January 1965.

7. "Airplane Airworthiness: Normal Categories," Federal Aviation Agency,Civil Aeronautics Regulation, Part 3, Washington, D.C., May 1956.

8. "Airworthiness Standards: Aircraft Engines," Federal Aviation Regulations, FAR Part 33, U. S. Department of Transportation, Federal Aviation Administration, Washington, D. C., 1985.

9. "Airworthiness Standards: Normal Category Rotorcraft," Federal Aviation Regulations, FAR Part 23, U. S. Department of Transportation, Federal Aviation Administration, Washington, D. C., 1985.

10. "Airworthiness Standards: Normal Category Rotorcraft," Federal Aviation Regulations, FAR Part 27, U. S. Department of Transportation, Federal Aviation Administration, Washington, D. C., 1985.

11. "Airworthiness Standards: Transport Category Airplanes," Federal Aviation Regulations, FAR Part 25, U. S.Department of Transportation, Federal Aviation Administration, Washington D. C., 1985.

12. "Airworthiness Standards: Transport Category Rotorcraft," Federal Aviation Regulations, FAR Part 29, U. S. Department of Transportation, Federal Aviation Administration, Washington, D. C., 1985.

13. "All the Ices," New York, Reinhold Publishing Corp., 1940.

14. "All-Weather Device Enters Production," Aviation Week, February 23, 1959.

15. "Anti-Icing and De-Icing-Defrosting Fluids," MIL-A-8243C, March 1965.

16. "Anti-Icing and Deicing Defrosting Fluids," MIL-A-8243C, with Amdt.1, January 17, 1984.

17. "Anti-Icing Equipment for Aircraft, Heated Surface Type, Amendment 2,"MIL-A-9482 (AV), April 1, 1981.

18. "Aviation Weather," Federal Aviation Administration Advisory Circular ACOO-6A, Washington, D.C., 1975.

19. "Aviation Weather Services," Department of Transportation, Federal Aviation Administration, AC 00-45B.

20. "British Civil Airworthiness Requirements," Air Registration Board, U. K.

21. "British Civil Airworthiness Requirements," Civil Aviation Authority,G610, Issue 2, Sept. 1, 1981.

22. "Certification of Small Airplanes for Flight in Icing Conditions," U.S Department of Transportation, Federal Aviation Administration, AC 23.1419-1, September 2, 1986.

23. "Civil Air Regulations, Part 4b, Airplane Airworthiness Transport Category," 1955.

24. "Cold Weather Operation of Aircraft," Department of Transportation,Federal Aviation Administration, AC 91-13C, 24 July 1979.

25. "De-Icer Repair Procedure Cold Patch Method for Surface Ply De-Icers,"Air supply Co., April 28, 1952.

26. "De-Icing System, Pneumatic Boot, Aircraft," MIL-D-88O4A, Sept. 1, 1958.

27. "Engine, Aircraft, Gas Turbine, Technical Design Requirements," MIL-STD-1534, Sept. 1, 1972.

28. "Environmental Control, Environmental Protection and Engine Bleed Air Systems, Aircraft," MIL-E-38453A, Dec.1, 1971.

29. "Environmental Test Methods and Engineering Guidelines," MIL-STD-81OD,July 1, 1983.

30. "Flutter Due to Ice or Foreign Substance On or In Aircraft Control Surfaces," Department of Transportation, Federal Aviation Administration, AC 20-93, 29 January 1976.

31. "General Design Specification Environmental Control, Airborne," MIL-E-87145 (USAF), February 1980.

32. "General Specifications for Design and Construction of Aircraft Weapon Systems - Fixed Wing Aircraft, Vol. I," SD-24K, June 1, 1982.

33. "General Specification for Design and Construction of Aircraft Weapon Systems - Rotary Wing Aircraft, Vol. II," SD-24K, Dec. 1, 1971.

34. "Handbook of Geophysics," U.S.Air Force, New York, The McMillan Co.,1960.

35. "Hazards Following Ground Deicing and Ground Operations in Conditions Conducive to Aircraft Icing," Department of Transportation, Federal Aviation Administration, AC 20-117, 17 December 1982.

36. "Justification for Update or Complete Revision of ADS-4," SAE ADS-4Review, April 21, 1982.

37. "Memorandum Report on Ice Research Base Activities,", 15 October 1944 to 15 April 1945, Serial No.IRB-45-22, Air Technical Service Command Ice Research Base, May 7, 1945.

38. "Military Specification-Engine, Aircraft, Turbojet, General Specification," MIL-E-5007B, July 27, 1951.

39. "Military Specification-Engines, Aircraft, Turbojet and Turbofan, General Specification For," MIL-E-005007E(AS), September 1, 1983.

40. "National Aircraft Icing Technology Plan," FCM-P20-1986, U.S.Department of Commerce/National Oceanic and Atmospheric Administration, Federal Coordinator for Meterological Services and Supporting Research, Washington, D.C., April 1986.

41. "Pilot Precautions and Procedures to be Taken in Preventing Aircraft Reciprocating Engine Induction System and Fuel System Icing Problems," Department of Transportation, Federal Aviation Administration, AC 20-113, 22 October 1981.

42. "Procedings of the Third Annual Conference on Environmental Effects on Aircraft and Propulsion Systems, September 19-20, 1963," AD-432-801L, September 1963.

43. "Report of Symposium Aircraft Ice Protection," AD-690-469, April 30,1969.

44. "Reports Published in 1985," Propulsion Systems Division, NASA Lewis Research Center.

45. "SAE Aerospace Applied Thermodynamics Manual ," Society of Automotive Engineers, Inc., Second Edition, October 1969.

46. "Selected Bibliography of NACA-NASA Aircraft Icing Publications," NASATM-81651, N82-11053/7, Aug. 1, 1981.

47. "Summary of Researches," Harvard-Mount Washington Icing Research Report 1946-1947, U.S. Air Materiel Command, Tech. Rept. No. 5676.

48. "Supplementary Bibliography of NACA Reports Related to Instrumentation and Research Techniques," NACA RM 52D11, June 1952.

49. "System Design Analysis," Department of Transportation, Federal Aviation Administration, AC No. 25.1309-1, September 1986.

50. "System Design Analysis," Department of Transportation, Federal Aviation Administration, AC No 25.1309-2, 1986.

51. "Systems Simplicity - A Major Design Goal," (Translation) Interavia, Special Supplement, Vol. 18, No. 11, pp. 1609-1612, 1963.

52. "Uniformly Conductive Surfaces," Icing Research Staff, Univ.of Michigan, Proj.M992-4, 1953.

53. "Use of Aircraft Fuel Anti-Icing Additives," Department of Transportation, Federal Aviation Administration, AC 20-29B, 18 January 1972.

54. Abbott, Ira H., Von Doenhoff, Albert E., and Stivers, Jr., Louis S.,"Summary of Airfoil Data," NACA Report 824, 1945.

55. Admas, R.I., "An Assessment of Icing Definitions," Presented at U.S.Army Training and Doctrine Command, Seminar on Helicopter Ice Protection, Fort Rucker, Alabama, February 1977.

56. Albright, A. E., "A Summary of NASA's Research on the Fluid Ice Protection Systems," AIAA Paper 85-0467, 19R5.

57. Arenberg, D. L. and Harney P., "The Mount Washington Icing Research Program," American Meteorological Society, Bulletin No.22, pp.61-63, February 1941.

58. Atthey, D. R., "A Finite Difference Scheme for Melting Problems," Journal Institute of Math. Appl. 13, 353, 1974.

59. Bauer, F., Garabedian, G., and Kron, D., "A Theory of Supercritical Wing Sections with Computer Programs and Examples," Lecture Notes in Economical and Mathematical Systems, Springer-Verlay, New York, 1972.

60. Beheim, M. A., "Executive Summary of Aircraft Icing Specialists Workshops," NASA Conference Publication 2086, July 1978.

61. Bernhart, W. D. and Zumwalt, G. W., "Electro-Impulse De-Icing: Structural Dynamic Studies, Icing Tunnel Tests and Applications," AIAA 22nd Aerospace Sciences Meeting, Reno, Nevada, January 9-12, 1984, AIAA Paper No.84-0022.

62. Bernhart, W. D., Gien, P. H., and Wilson, B. K., "Structural Dynamics Investigations Related to EIDI Applications," AIAA-86-0550, AIAA 24th Aerospace Sciences Meeting, January 6-9, 1986.

63. Berry, F. A., Bollay, E., and Beers, N. R., "Handbook of Meteorology,"New York, NY, McGraw Hill Co., 1945.

64. Blair, T. A. and Fite, R. C., "Weather Elements," Prentice-Hall Inc.,Inglewood Cliffs, NJ, 1965.

65. Borovikov, A. M ., "Cloud Physics," (Translation) Gidrometeoizdat, 1961.

66. Bowditch, Nathaniel, "American Practical Navigator," U. S. Navy Hydro-graphic Office, 1966.

67. Bowers, R. D., "Icing Report by the University of California, Fiscal Year 1946," AAF Tech. Rep. 4429, Sections III and VII, November 1946.

68. Bowers, R. D., "Basic Icing Research by General Electric Company, FiscalYear 1946," AAF Tech. Rep. 5539, January 1947.

69. Breeze, R. K. and Clark, G. M., "Light Transport and General Aviation Aircraft Icing Research Requirements," NASA CR-165290, 1981.

70. Brull, M. A. and Tribus, M., "A Selected Bibliography of French Reports in the Field of Aircraft Icing," Engr. Res. Inst., Univ. of Michigan, ASTIA AD-18638, March 1953.

71. Brun, E. A., "The Mechanics of Suspensions," Univ.of Michigan, Airplane Icing Information Course, Lecture 2, 1953.

72. Brun, E. A., et al, "Proceedings of the Third AGARD General Assembly,"Presented at the London AGARD Conference, September 3-11, 1953.

73. Brun, E., "A Study of Convection in Clear Air and Wet Air," (Translation)Technical Note No. 9, North American Aviation, April 1954.

74. Buck, Robert N., "Weather Flying," MacMillian Publishing Co.Inc., NewYork, N.Y., 1978.

75. Bush, W. F., "Safeway-Goodyear De-Icing Boot Structural Flexing Test Model F94A&B," ASTIA, AD-11482, Lockheed Aircraft Corp., Rept. No. 9046, January 1953.

76. Camp, D. W. and Frost, W., "Proceedings: First Annual Workshop on Meteorological and Environmental Inputs to Aviation Systems," NASA CP-2028/ FAA-RD-77-173, Washington, D. C., 1977.

77. Camp, D. W. and Frost, W., "Proceedings: Third Annual Workshop on Meteorological and Environmental Inputs to Aviation Systems," NASA CP-2104/ FAA-RD-77-173, Washington, D. C., 1979.

78. Camp, D. W. and Frost, W., "Proceedings: Fifth Annual Workshop on Meteorological and Environmental Inputs to Aviation Systems," NASA CP-2192/ FAA-RD-77-173, Washington, D. C., 1981.

79. Camp, D. W., et al, "Sixth Annual Workshop on Meteorological and Environmental Inputs to Aviation Systems, 26-28 October 1982, Tullahoma, TN," A84-23424, Jan. 1, 1984.

80. Chertkov, Ia. B., "Additives to Fuels for Jet-Propelled Aircraft/Survey," Khimiia i Teknologiia Topliv i Masel, Vol. 16, No. 8, pp. 59-61.(In Russian.)

81. Crowe, C. T., Nicholls, J. A., and Morrison, R. B., "Drag Coefficients of Inert and Burning Particles Accelerating in Gas Streams," Ninth Symp.(Int'l.) on Combustion, Academic Press. 1963, pp. 395-405.

82. Davis, D., "2.75-Inch Rocket Launcher Ice Protection Tests," December1975 to February 1976," RL 76-13, March 18, 1976.

83. DeWitt, K. J., "Numerical Simulation of Electrothermal De-Icing Systems,"AIAA-83-0114, January 1983.

84. Diem, M., "Contributions to the Problem of Ice Formation," (Translation)U. S. Air Force Translation No. F-TS-533-RE, May 1946.

85. Dorsey, E. N., "The Freezing of Supercooled Water," American Philosophical Society, Transactions, 38, Pt. 3, pp. 248-328, Nov. 1948.

86. Doten, F. S., "Icing Program Management Techniques," Proc. Annu. Symp. Soc. Flight Test Eng. 11th, Flight Test in the Eighties, Paper 2, 1980.

87. Eshbach, O. W. and Souders, M., "Handbook of Engineering Fundamentals,"Third Edition, Wiley and Sons, New York, 1974, p. 843, Table 3.

88. Evanich, P. L., "NASA Lewis Research Center's Icing Res. Prog. Proceedings: Fifth Annual Workshop on Meteorological and Environmental Inputs toAviation Systems," NASA CP-2192, Jan. 1, 1981.

89. Evans, W. H. and David, E. J., "Biodegradation of Mono-, Di-, and Triethylene Glycols in River Waters," Water Research, Vol, 8, pp.97-100.

90. Felts, M. F., "Effects of Exposure to Ethylene Glycol on Chimpanzees," Aerospace Medical Research Laboratory, WPAFB, Rept.AMRL-TR-69-130, 1969, pp, 105-120.

91. Fraser, D. and Rush, C. K., "Notes on the Advantages of High Specific Power Inputs for Electro-Thermal De-Icing," Report No.LT-149, National Aeronautical Establishment, Canada, September 13, 1955.

92. Frost, W. and Camp, D. W., "Proceedings: Second Annual Workshop on Meteorological and Environmental Inputs to Aviation Systems," NASA cp-2057/FAA-RD-78-99, Washington, D. C., 1978.

93. Frost, W. and Camp, D. W., "Proceedings: Fourth Annual Workshop on Meteorological and Environmental Inputs to Aviation Systems," NASA CP-2139/FAA-RD-78-99, Washington, D. C., 1980.

94. Frost, W. and Camp, D. W., "Proceedings: Sixth Annual Workshop on Meteorological and Environmental Inputs to Aviation Systems," NASA CP-2274/ FAA-RD-78-99, Washington, D. C., 1982.

95. Gardner, T. B., "Investigation of Runback," Air Materiel Command, Ice Research Base Rep. No. IRB 46-36-1F, July 1946.

96. Gollings, D. H. and Newton, D. W., "A Simplified Criterion to Certify Light Aircraft for Flight In Icing," SAE Paper No. 740349, April 1974.

97. Guffond, D., et al, "Overview on Icing Research at Onera," AIAA 85-0335,Jan. 14, 1985.

98. Gunn, R. and Kinser, G. D., "The Terminal Velocity of Fall for Water Droplets in Stagnant Air," Journal of Meteorology, Vol. 6, 1949.

99. Henschke, G. E., Peterson, A. A., Cozby, D. E., and Steele, M. A., "Rationale for Research Effort to Achieve Aircraft Icing Certification Without Natural Icing Testing," FAA/DOT/CT-86/4, Boeing Vertol Company, May 1986.

100. Hobbs, "Ice Physics," Clarendon Press, 1974.

101. Holmes, W. K., "Instrumentation of Airfoil for De-Icing Test (Model General)," Douglas Aircraft Company, Santa Monica Plant, Calif., 1944.

102. Horne, T. A., "The Icing Options: Avoid Ice If You Can, Deal Mth It If You Must," AOPA Pilot, February 1981, pp. 52-63.

103. Horne, T. A., "Understanding Ice," AOPA Pilot, February 1981, pp. 80-86.

104. Horne, T. A., "Reflections on a Black Art: The Unknown Icing Certification," AOPA Pilot, September 1981, pp.43-48.

105. Hudson, V., "Icing Problems Progress Report, by NACA Subcommittee,"Convair, San Diego, November 6, 1957 (Confidential).

106. Huschke, R. E., et al, "Glossary of Meteorology," Third Printing,American Meteorological Society, boston, MA., 1980.

107. Ikrath, K., "Interference with Aircraft Radio Navigation and Communications by Precipitation Static from Ice and Snow Clouds (Electrostatic Wind Tunnel Experiments)," Army Electronics Command, Fort Monmough, N.J., ECOM-4244, AD-784-623/1, August 1974.

108. Jacobs, E. N. and Abbott, I. H., "Airfoil Section Data Obtained in the NACA Variable-Density Tunnel as Affected by Support Interference and Other Corrections," NACA TR 669, 1939.

109. Jacobs, E. N., "Airfoil Section Characteristics as Affected by Proturber-ances," NACA Rep. 446, 1932.

110. Jones, A, R. and Zalovcik, J. A., "Flight Investigation of a Stall Warning Indicator for Operation Under Icing Conditions," NACA RB (WR L-503), July 1942.

111. Khaltiner, Dzh., and Martin, F., "Dynamical and Physical Meteorology,"(Translation) IL, 1960.

112. Khrgiyan, A. Kh., "Atmospheric Physics," GIFML, Moscow, 1958.

113. Koegeboegn, L. P., "Commercial Aviation Icing Research Requirements,"NASA CR-165336, 1981.

114. Kramer, C., "Electric Charges on Rime-Covered Surfaces," Koninlijk Nederlands Meteorologisch Instituut, No. 12, The Hague, 1948.(Summaries in Dutch, English and German.)

115. Lane, W. R. and Dorman, R. G., "Further Experiments on the Shatter of Drops by a Supersonic Air Blast," Porton Tech.Paper No. 279.

116. Lane, W. R. and Edwards, J., "The Break-Up Drops in a Steady Stream of Air." Porton Technical Paper No. 71.

117. Langmuir, I., "Final Report on Icing Research up to July 1, 1945,"General Electric Co. Research Laboratories, October 1945.

118. Le Sueur, H. E., "Icing Standard and Methods Used to Determine the Suitability of Aircraft to Fly in Icing Conditions," Aircraft Ice Protection Conference, 1958.

119. Leadon, B. M. and Anderson, G. E., "Status Report of Efforts to Obtain Adequate Intensity Distribution," RDO No. R-664-802 SR-li, Contract No.AF 33(616)-2408, August 26, 1955.

120. Levin, L. M., "Sedimentation of Aerosol Particles Out of Flow on Obstacles," DAN SSSR (Reports of the USSR Academy of Sciences), Vol. 91, No. 6, 1953.

121. Lewis, W., "Review of Icing Criteria," Aircraft Ice Protection, Report of Symposium, DOT/FAA Flight Standards Service, Washington, D.C.," April 28, 1969.

122. Maeno, N., "Physics of Snow and Ice," Hokkaido University, Sapporo,Japan, 1967.

123. Masters, C. O., "The Federal Aviation Administration's Engineering and Development Aircraft Icing Program," AIAA-85-15, January 1985.

124. McDonald, J. E., "Theoretical Cloud Physics Studies," Iowa State College, Dept. of Physics, Office of Naval Research, U.S. Navy Dept. Project NR C82-093, January 1953.

125. McPhail, D. C., "Some Problems in Canadian Aeronautical Research and Development," AGARD 4th Gen. Ass., Scheveningen, 1954.

126. Meyson, B. Dzh., "Cloud Physics," (Translation) Gidrometeoizdat,Leningrad, 1961.

127. Miller, Albert and Thompson, Jack C., "Elements of Meteorology," Second Addition, Charles E. Merrill Publishing Company, 1975.

128. Newton, Dennis W., "Severe Weather Flying," AOPA, McGraw-Hill Book Co.,New York, N. Y., 1983.

129. Newton, D., "General Aviation Meteorological Requirements," AIAA 84-0015,Jan. 9, 1984.

130. Olsen, A. F., "Survey of Icing Research," U. S. Air Technical Service Command, Engr. Division Technical Note, Ser. No. TN-TSEST-5-9, Wright Field, March 1946.

131. Paramasivam, T. and Zumwalt, G. W., "The Structural Dynamics of Electro-Impulse De-Icing on the Lear Fan Kevlar Composite Leading Edge," Aerospace Engineering Department, Wichita State University, Wichita, Kansas.

132. Pchelko, I. G., "Meteorological Conditions of Flights at Great Heights,"(Translation) Gidrometeoizdat, 1957.

133. Petach, A., "A Summary of Aircraft Icing Criteria," The Boeing Co. Vertol Division.

134. Petterssen, S., "Recent Fog Investigations. Part I - The Physics of Fog. Part II - Meteorological Conditions for the Formation of Fog," Journal Aero. Sci., January 1941.

135. Pettit, K. G., "The Rockliffe Ice Wagon and Its Role in Canadian Icing Research," Royal Meteorol. Soc., Reprint, September 1951.

136. Pinkel, B., Noyes, R. N., and Valerino, M. F., "Method for Determining Pressure Drop of Air Flowing Through Constant-Area Passages for Arbitrary Heat-Input Distributions," NACA TN 2186, 1950.

137. Pope, A., "Wind Tunnel Testing," John Wiley and Sons, Inc., New York,1947.

138. Reed, R. J. and Kreitzberg, C. W., "Application of Radar Data to Problemsin Synoptic Meteorology. Final Report," AFCRL-63-22, December 1962.

139. Reinmann, J. J., et al, "AircraN Icing Research at NASA," First International Workshop on Atmospheric Icing of Structures, Hanover, New Hampshire, NASA TM-82919, N82-3029717, Jan. 1, 1982.

140. Reinmann, J. J., Shaw, J. R., and Olsen, W. A., "NASA Lewis Research Center's Program on Icing Research," AIAA Paper 83-0204, NASA 1M83031, 1983.

141. Robert, P. A. and Stark, R. S., "Index of AIRL Reports (Supplement l),"AIRL Engineering Report No.56-9-1, September 1956.

142. Rudolph, J. D., "Outline of Tests Conducted by North American Aviation at Mt. Washington During the 1950-51 Icing Season Project Sunmit," North American Aviation, Inc., May 1951.

143. Ruffner, James A. and Bair, Frank E., (Editors), "The Weather Almanac,"Gale Research Company, Second Addition, 1977.

144. Ruggeri, R. S., "General Correlation of Temperature Profiles Downstream of a Heated Air Jet Directed at Various Angles to Airstream," NACA TN 2855, 1952.

145. Ruskin, et al, "Development of the NRL Axial Flow Vortex Thermometer,"NRL Report No. 4008.

146. Scavuzzo, R. J., Chu, M. L., and Olsen, W. A., "Structural Dynamics Investigations Related to EIDI Applications," AIAA Paper 86-0550.

147. Schulz, M. and Comerton, L. J., "Effect of Aircraft De-Icer on Airport Storm Runoff," J. Water Pollut. Control Fed., Vol. 46, No. 1, pp. 173-180, January 1974.

148. Shaw, R. J., "Progress Toward the Development of an Aircraft Icing Analysis Capability," NASA TM 83562, 1983.

149. Sogin, H. H. "A Design Manual for Thermal Anti-Icing Systems," Wright Air Development Center, WADC Tech. Rep. 54-313, December 1954.

150. Stickle, J.W., et al, "Operating Safely in Adverse Weather Environments," N84-15203, Nov.1, 1983.

151. Taylor, G. I., "Notes on Possible Equipment and Technique for Experimenton Icing on Aircraft," BARC-RM 2O24, Jan. 1, 1940.

152. Theiss, E. C., "Low Temperature Test Instrumentation C-54G No.45-559 1945-46," Climatic Requirements Office, Engineering Stds.Section, Engineering Division - ATSC, 1946.

153. Thompson, J. K., "1954 Icing Presentation for Major Commands," Technical Note No.WCT 55-26, Wrisht Patterson Air Force Base, April 1955.

154. Trannehil, I. R., "Weather Around the World," Princeton, N. J., Princeton Univ. Press. 1943.

155. Tribus, M. and Boelter, L. M. K., "An Investigation of Aircraft Heaters. II-Properties of Gases," NACA A.R.R., October 1942.

156. Tribus, M."Modern Icing Technology.Chapter II," Univ.of Michigan,Engr.Res.Inst., January 1952.(Proj.M992-E.)

157. Tuck, D. A., "IFR Airworthiness Standards for VTOL Aircraft," AHS, AIAA, U. of Texas, Proc.of Joint Symp.on Environmental Effects on VTOL Designs, Arlington, Tex., November 16-18, 1970.

158. Von Glahn, U. H., "The Icing Problem: Current Status of NACA Techniques and Research," Paper Presented at Ottawa AGARD Conference, June 10-17, 1955, AG 19/P9.

159. Von Mises, R., "Theory of Flight," McGraw Hill, 1945.

160. Weidel, E. P., "Enter AFOS: New National Weather Net Nears," NJAA Pre-print, Vol.8(2), April 1978.

161. Weiss, I., "Is Aircraft Icing No Problem Any More for Modern Air Traffic?," Wetter and Leben, Vol. 21, No. 5-6, pp. 89-97. (In German.)

162. Welty, J. R., Wicks, C. E., and Wilson, R. E., "Fundamentals of Momentum,Heat and Mass Transfer," Wiley, 1969.

163. Zumwalt, G. W., Schrag, R. L., Bernhart, W. D., and Friedberg, R. A., "Analysis and Tests for Design for an Electro-Impulse De-Icing System," NASA CR-174919, May 1985.

CHAPTER IX
SUBJECT INDEX

CHAPTER IX

CONTENTS

SECTION 1.0 SUBJECT INDEX

A

D

E

G

H

J

K

L

M

P

R

☆U.S. GOVERNMENT PRINTING OFFICE: 1991 - 504-061/40031